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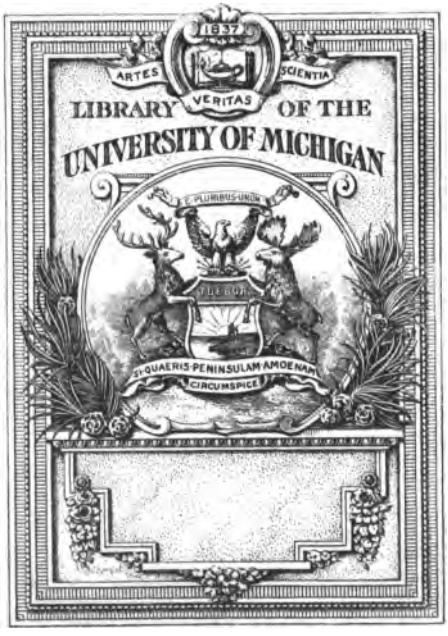
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1888. Koch, R., M.D., 36, Klosterstrasse, Berlin.
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N.R. 1875. Hime, T. W., M.D., 54, Horton Road, Bradford, Yorkshire.
C. 1853. Hirsch, August, M.D., 113, Pottsdamer Strasse, Villa 2, Berlin.
N.R. 1871. Hogg, F. R., M.D., R.H.A. (*address unknown*).
N.R. 1875. Home, Sir Anthony D., K.C.B., V.C., M.D., Surg.-Gen., India.
N.R. 1866. Home, A. H., M.D., Hullerhirst, Steventon, Ayrshire.
C. 1851. Hoskins, S. E., Guernsey.
N.R. 1887. Hunt, J. P., Sheerness Hospital, Kent.
N.R. 1881. Irwin, Chamney Graves, M.D., Dep.-Surg.-Gen., Edinburgh, N.B.
N.R. 1855. Jacobson, T. E., Sleaford, Lincolnshire.
C. 1886. Janssen, —, M.D., Inspecteur en Chef d'Hygiène, Brussels.
N.R. 1888. Karkeek, P. G., Isca, Torquay, Devon.
C. 1851. Kellay, —, M.D., Beyrout, Syria.
N.R. 1887. Kelly, C., M.D., Ellesmere Road, Worthing.
N.R. 1883. Kirker, Gilbert, R.N., M.D., R.N. Hosp., Gosport.
C. 1857. Leas, Jose Fernandes da Silva, Cape de Verde.
C. 1875. Lent, —, M.D., Cologne.
C. 1886. Le Roi de Méricourt, L., M.D., 5, Rue Cambacères, Paris.
N.R. 1879. Lilburne, James, M.D., Dep. Inspec.-Gen., Duncrivie House, Milnathort, N.B.
C. 1851. Litt, W., Veterinary Surgeon, Shrewsbury, Salop.
N.R. 1873. Little, James, M.D., 14, Stephen's Green North, Dublin.
N.R. 1885. Lloyd, W. Harris, M.D., Dep. Inspec.-Gen. (*gone abroad*).
C. 1857. Lowtzoff, —, St. Petersburg, Russia.
N.R. 1881. Lyons, R. T., M.D., Surgeon-Major, Rampart Barracks, Fort William, Calcutta.
C. 1887. McLaurin, H. A., M.D., Sydney, New South Wales.
C. 1870. Mallet, —, M.D., Warsaw.
N.R. 1865. Mapother, E. D., M.D., 6, Merrion Square North, Dublin.
N.R. 1867. Marshall, John, 13, Liverpool Street, Dover.
N.R. 1860. May, George, jun., 43, Castle Street, Reading, Berks.
N.R. 1889. McVail, John C., M.D., Kilmarnock, Ayrshire.
C. 1854. Moffatt, Thomas, M.D. (*address unknown*).
C. 1886. Moleschott, Jacob, M.D., Rome.
N.R. 1872. Moore, John Wm., M.D., 40, Fitzwilliam Square West, Dublin.
N.R. 1884. Moore, W. J., C.I.E., Surg.-Gen. (*address not known*).
C. 1851. Monzon, Rafael, Barbacaos, New Grenada.
C. 1853. Neumann, —, M.D., Berlin.
C. 1851. Noble, Daniel, M.D., 258, Oxford Road, Manchester.
N.R. 1881. Oldham, Chas., Brigade Surg. Ind. Med. Dept., Shurdington Road, Cheltenham.
C. 1872. Poggio, Don Ramon Hernandez, Cuba.
C. 1854. Purple, S. S., M.D., New York, U.S.A.
N.R. 1879. Ransom, W. H., M.D., F.R.S., Nottingham.
N.R. 1875. Ransome, Arthur, M.D., F.R.S., Devisdale, Bowdon, Cheshire.
N.R. 1884. Ray, George, Surg.-Gen., 76, Jermyn Street, S.W.

Elected.

N.R. 1880. Reid, Sir J. Watt, K.C.B., M.D., R.N.
N.R. 1874. Reid, Walter, M.D., Fleet-Surgeon, Royal Naval Hospital, Haslar.
N.R. 1866. Robertson, James, M D., Alfred Place, Melbourne.
C. 1886. Rochard, G., M.D., Paris.
N.R. 1863. Rowe, T. Smith, M.D., Cecil Street, Margate.
N.R. 1879. Ross, J. T. C., C.I.E., Surgeon-General Ind. Med. Dept., The Grove, Ryde, Isle of Wight.
N.R. 1881. Russell, E. G., M.B., B.Sc., Surg. Ind. Med. Dept., Gauhàti, Assam, India.
N.R. 1875. Russell, J. B., M.D., 1, Montrose Street, Glasgow.
N.R. 1859. Sanderson, J. Burdon, M.D., F.R.S., 64, Banbury Road, Oxford.
C. 1851. Sankey, F. F., Malta.
C. 1879. Sarell, Richard, M.D., Pera and Therapia, Constantinople.
C. 1873. Schleisner, —, M.D., Copenhagen.
C. 1874. Schlimmel, —, M.D., Teheran.
C. 1852. Schürmayer, Professor, Heidelberg, Germany.
N.R. 1858. Scratchly, G., New Orleans, U.S.A.
C. 1851. Sharpe, Richard, Beverley Road, Hull.
N.R. 1869. Shaw, James, Insp.-Gen. (*address not known*).
C. 1853. Sigmund, C. L., Vienna.
N.R. 1888. Smith, F., Montreal, Cargate Avenue, Aldershot.
N.R. 1867. Smith, R. Wagstaff, Mount Rundell, Harborne, Birmingham.
C. 1886. Sonsino, Prospero, 11, Via San Lorenzo, Pisa.
N.R. 1854. Spinks, C. N., Sankey Street, Warrington.
C. 1851. Spooner, W. C., Vet. Surg., Southampton.
C. 1876. Sternberg, Geo. M., M.D., United States Army, Port Point, San Jose, San Francisco, California.
N.R. 1885. Sturridge, P. F., Kendal, Westmorland.
N.R. 1880. Tatham, John, M.D., Town Hall, Salford, Manchester.
C. 1860. Taylor, H. Sharp, 15, Quarry Street, Guildford.
C. 1855. Tholozan, J. Désiré, M.D., Teheran.
C. 1888. Thompson, Ashburton, M.D., Sydney, New South Wales.
N.R. 1853. Todd, J. George, Evenwood, West Auckland, Durham.
N.R. 1885. Tomes, Arthur, Surg. Ind. Med. Service, Bengal.
N.R. 1873. Townsend, Stephen Chapman, C.B., Surg.-Gen. Ind. Med. Dept., Sanitary Commissioner for Central India.
C. 1851. Tribes, E., Nismes, France.
C. 1855. Tribuchet, Adolphe, Paris.
C. 1853. Valerj, —, M.D., Rome.
C. 1855. Virchow, Rudolf, Professor, 10, Schellings Strasse, Berlin.
C. 1856. Von Iffland, —, Beaufort, New Quebec.
N.R. 1879. Watson, Alexander, M.D., R.N., Dep. Insp.-Gen., Army and Navy Club
C. 1853. Watson, John, M.D., Jamaica.
N.R. 1887. Welch, Henry, M.D., Blackpool, Lancashire.
N.R. 1880. Whishaw, J. C., M.D., Surg.-Major Ind. Med. Dept., Lucknow.
N.R. 1880. White, J. Berry, M.D., Surg.-Major Ind. Med. Dept. (*address not known*).
C. 1861. Whitelaw, Wm., M.D., Kirkintilloch, Dumbartonshire.
N.R. 1854. Wiblin, John, Southampton.
N.R. 1865. Williams, C., 48, Prince of Wales's Road, Norwich.
N.R. 1884. Williamson, R. E., M.B., Brookfield, Lymm, Cheshire.
N.R. 1872. Woodall, John (*address not known*).
N.R 1875. Wortabet, John, M.D., St. John's Hospital, Beyrout.

TRANSACTIONS
OF THE
Epidemiological Society of London.

ON THE EPIDEMIC OF CHOLERA IN MALTA DURING 1887.

By DAVID BRUCE, M.B., C.M., Surg. M.S.

(*Read: November 14th*, 1888.)

Mr. President and Gentlemen,—Malta, the principal island of a small group called the Maltese Islands, which comprises Malta, Gozo, and Comino, is situated some 50 miles south of Sicily, which can easily be seen on a clear day, and some 200 miles east of the African mainland. The main geographical fact to be noted is that Malta, subject as it is to visitations of cholera, lies in a direct path of commerce, *vid* the Suez Canal, between England, Spain, France, and the East, and is visited for the purpose of coaling or commerce by a large number of outward and inward bound steamers, sailing on this route under these flags. Again, on account of its proximity to Sicily, numerous small craft are constantly plying between the two islands, bringing fish, vegetables, fruit, wine, etc., to the smaller and less productive island.

Malta is a very small island, being only some 17 miles long and 9 miles broad. It is separated from the neighbouring island of Gozo by a narrow strait, some 4 miles wide, in which lies the islet of Comino.

The island is built up altogether of sedimentary rocks, which have been divided by various geologists into upper and lower limestones, and various intermediate beds of sandstone. These beds of sandstone are mostly formed of a very porous stone, and are traversed by innumerable fissures. Between the sandstones and the upper limestone there is a bed of marl, which plays an important function in regard to the water-supply of Malta. The eastern half of the island,

and by far the most populous part, has been denuded of the upper limestone and marl, so that almost all the cities and villages of Malta are built on a porous sandstone. The rocks are usually regarded by geologists as belonging to the Pliocene formation. A microscopical examination shows that the upper and lower limestones are composed of corallines, calcareous algæ, and large foraminifera; whereas the so-called sandstones are made up of pelagic foraminifera, resembling in many respects, and to a very large extent, deep sea deposits.

Malta is one of the most densely populated places in the world. According to Dr. Cousin, the able author of the last census, the proportion of the population, exclusive of Her Majesty's troops, is 1443.12 to the square mile. Nearly one-half of this population (67,000) is concentrated, as might be expected, in the vicinity of the magnificent harbour, called the Grand Harbour, the shipping of which affords employment to thousands of the poorer inhabitants of the neighbouring cities and villages.

Valletta, the capital of Malta, is situated upon a tongue of land which forms the western boundary of the Grand Harbour and separates it from the Marsamuscetto or Quarantine Harbour. In its vicinity, near the base of the tongue, is its suburb, Floriana. On the other side of the Grand Harbour are the dense centres of population known as the three cities, or the three fortified cities. Two of these, namely, Senglia and Vittoriosa, are also situated upon tongues of land which run into the Grand Harbour at right angles to the peninsula, upon which Valletta and Floriana are built. At the base of these two cities, but separated by a small intervening space, is situated the third of the fortified cities, namely Cospicua.

Valletta is a handsomely built city, and to a stranger passing through appears to be very clean, but the houses are badly constructed, being lofty and built round narrow, well-like courts, down which little sunlight and pure air can struggle. The area of Valletta is only one-third of a square mile, and into this narrow space are crowded some 25,000 persons, the proportion of its population being therefore more than 78,000 to the square mile. If the area covered by the numerous sparsely populated buildings, such as the palace, the club, and the very numerous churches, was deducted, this proportion would be found to be much greater.

The most densely populated part of Valletta is called the Manderaggio. This quarter, inhabited by a very poor class of people, principally boatmen, is situated close to the Mar-

samuscetto Harbour, and only some few (14) feet above the level of the sea. It covers two-and-a-half acres, upon which dwell 2,544 persons, giving a proportion of 636,000 to the square mile. Another very densely populated and low-lying quarter is that of Strada Fontana, which lies in a deep hollow behind the fortifications. It is also inhabited by the very poorest class. When we come to treat of the deaths from cholera in Valletta during the late epidemic, we shall find that they mostly took place in these two low-lying localities, and not on the higher parts of the ridge.

Floriana, the suburb of Valletta, is a small, regularly built town. It has a population of 7,000, and is even more crowded than Valletta, the average number of persons to each inhabited dwelling being 10.44, whereas the average number in Valletta is 6.60. But it must be borne in mind that Floriana is situated in an isolated and healthy position.

The three fortified cities may be described together, and in a few words. The buildings are similar in structure to those of Valletta, but are inhabited by a poorer class of people. Senglia and Vittoriosa are both built upon high ridges with steep sides. Cospicua, of the three, is the most huddled together, over-crowded, and has the poorest class of population. The worst corner in Cospicua is called San Michèle, which has the reputation of always supplying the greatest number of cases in every epidemic.

Let us now direct our attention for a few minutes to the country villages or casals of Malta. These may be divided into two sets, viz., those lying towards the eastern end of the island, and those lying between Valletta and Notabile, the ancient capital. The villages lying to the east are inhabited by the least civilised of the Maltese, and in truth these people may be described as semi-barbarians. Let me attempt a description of their dwellings. Just outside the fortifications which surround the three cities lies the village of Zabba, and a short distance further on the village of Zeitun. These may be taken as typical villages of the eastern set, and as they showed the highest proportion of cases and deaths during the last epidemic, it will be useful to describe them somewhat fully. In these two casals the construction of the houses is very different from that which obtains in Valletta and the three cities. Let us begin with the unit, or building inhabited by one family. The plan is very simple, and was probably devised for motives of safety, when the island was apt to be overrun by any piratical crew. There is first built a square enclosure of the surrounding sandstone. The size of this enclosure, we shall say, is 20 feet square and 12

or 14 feet high. In one of the sides a doorway is built for the purpose of gaining access to the interior. Against the inner walls are built various-sized cabins with flat roofs. These cabins have no windows, but depend altogether for light and ventilation on a doorway. When these cabins are ranged against the walls the original building area of, say, 50 square yards is reduced to some 10 or 12. This remains roofless, and is the courtyard. These enclosures are closely packed together in double rows, and the lane running between them is, in many I have examined, not more than 6 or 7 feet wide. So that these villages, as Dr. Sutherland pointed out in 1865, resemble nothing so much as aggregations of small farm-buildings and farmyards, each enclosed within its separate wall.

In the small courtyard of one of these village houses all the operations of life are carried on, such as cooking, eating, washing, etc. In one corner may be seen an uncovered and exceedingly primitive privy. In another the opening of the tank for drinking-water. Near the door of the living-room there is often scooped out a hole or cellar into which is thrown all the refuse resulting from cooking operations. One of the cabin-like structures is used as a manure-room, wherein is stored as much filth and rubbish as possible, to be sold at intervals to the neighbouring farmers to spread over the fields. In others are found rabbits, poultry, and possibly a goat or pig. In a pent-up enclosure of this kind, reeking with all sorts of smells and swarming with flies and vermin, there usually lives a man, his wife, and family of several children. These miniature courtyards are often very picturesque, with flowering plants scattered about, or a bright green vine trailing its branches irregularly over a corner of the enclosure, or partly roofing it by being trained along rude trellis-work. These plants, as might be expected, grow luxuriantly in the rich atmosphere of the courtyards, where they are protected from every breath of air.

The other, or central set of villages, lying between Valletta and Notabile, of which Hamrun, Zebbug, and Birchircara are examples, are much more civilised than the eastern set, and as there has been a great increase of population in this part of the island of late years, very many of the houses are of modern construction. They are also more open, often have gardens, and may be said generally to take an intermediate position as regards their sanitary condition among the cities and villages of Malta.

Having thus dwelt briefly on the form of dwelling and population of the cities and villages of Malta, let us turn to an important point, namely, their water-supply.

Valletta, the capital, and Floriana, its suburb, are supplied principally by water collected from springs in the upper limestone hills, some eight miles to the south-west. In the paragraph on the geological formation of Malta, it will be remembered that, lying under the upper limestone, there is a bed of marl. Headings are driven for great distances at the junction of the limestone and marl, and the water, percolating through the very porous limestone, is caught on the marl, and finds its way in small streams along these headings, to be collected and conveyed to Floriana and Valletta by the Wignacourt Aqueduct.

This water is principally conveyed in iron pipes, so that at the time of the last epidemic Floriana and Valletta had a constant supply under pressure of pure drinking-water. This water could be obtained from numerous public taps, and had also been introduced into many of the houses. Notably, all the barracks had been supplied with this water. It must be noted, however, that in many of the houses this water was still stored in tanks under the houses.

This is a great improvement on what obtained in Valletta during the epidemic of 1865. At that time the water was conveyed in stone channels, by means of which the tanks under the houses were filled from time to time. These stone channels and underground tanks exposed the water to contamination.

The three cities are supplied by water conveyed from the south side of the island by the Fawara Aqueduct, but until a recent date this water was stored in the underground tanks; in fact, it was only in June 1887 that a constant supply under pressure was introduced. The cholera broke out a month later, when the new supply had just come into operation.

The central set of villages lying between Valletta and Notabile, viz., Hamrun, Birchircara, Leggieni, and Zebbug receive a plentiful supply of good water, but this is stored principally in underground tanks. Rabato and Notabile are provided with a good water-supply, but a large quantity of the water consumed is from roofs and wells beneath houses. Other villages, such as Attard, Balzan, Lea, and Musta, receive in winter an abundant supply of aqueduct water; but this again is stored in underground tanks, and largely used for agriculture.

The villages to the eastern end of the island—Zabbar, Zeitun, etc.—have the worst water-supply. The only source at the time of the outbreak of cholera in 1887 was the water collected from the roofs, courtyards, and lanes of the

villages. In fact, in many of these enclosed dwellings which I have examined the rain is led by pipes from the roofs of the cabins to the courtyard, across which it streams and gains access to the tank through an opening in the neck on a slightly lower level than the courtyard. From the description given above of the general filthy condition of these courtyards—swarming with children, dogs, and poultry —some idea of the contaminated condition of the water in these tanks may be formed. The water in these tanks, as a rule, is so foul, that the wonder is, not that an occasional outbreak of cholera occurs, but that there is a single living being left in these villages for the cholera to attack. I have myself examined many samples of these tank-waters, and found them all foul. In some instances, the water, on being freshly drawn, was of the colour of pale sherry. In a pamphlet written lately by Dr. Carnana-Scicluna, the Government analyst, the analysis of the water contained in the various public tanks of these villages is given. These analyses were made in August 1887, at the height of the cholera epidemic. In Zabbar there were two tanks examined, and both found to be bad; in Zeitun, five tanks—one returned as good, two as bad, and the remaining two as very bad.

In order to give a general idea of the condition of tank-waters throughout the cities and villages of Malta, I may quote from another part of the same pamphlet, where Dr. Carnana-Scicluna states that during the last four years he has examined 1,933 examples of water, of which 1,385 were found to be unfit for drinking; 132 were suspicious; and only 418 returned as good. Among the samples returned as unfit, 679 were found to be undoubtedly contaminated by sewage.

Of course, it may be objected that these waters sent for analysis were suspected as being bad. I therefore take from the same source the following facts. In April 1886, 69 samples of water were taken indiscriminately by the police authorities from the tanks of various public-houses in the three cities, and of these 34 per cent. were found to be contaminated. Another instance may be given of 107 samples of water taken from houses in which had occurred cases of typhoid fever or cholera, and only 26 of which were found to be fit for drinking; the others were all more or less contaminated, 28 being returned as particularly foul.

Perhaps I may be permitted to give here the results of some bacteriological investigations made by myself during the present year. The object of these investigations was

to note the number of bacteria in the various drinking-waters, and to isolate the different species.

In the first place, samples were taken from the far end of various headings of the before-mentioned Wignacourt Aqueduct. These samples of water were taken in Sternberg's bulbs, by cutting off the tip of the tube with sterilised pincers, while the point was held in the water as it came directly from the living rock, and immediately afterwards hermetically sealed in the flame of a spirit-lamp. Plate-cultivations were afterwards made by mixing 1 c.c. of this water with 9 c.c. of nutrient gelatine.

The number of colonies of bacteria which grew on the plates were counted after the lapse of eight days. It seems to me an interesting and curious fact that the samples of water taken from these headings were found to be almost quite sterile, in two instances absolutely so, as will be seen from the following table, which gives—

Name of Headings.	No. of Experiments.	Average No. of Bacteria per c.c.
Ghan Kyat Heading	7	3.5
Buonura Heading	2	0
Weid el Busbeis Heading ...	2	5

As I mentioned in a previous part of this paper, the water of the Wignacourt Aqueduct is mainly conveyed to Valletta in iron pipes. But near the headings some of the vennules run in open stone channels for a short distance, and the water at these spots is exposed to some slight risk of gaining impurities. When we examine the water after it reaches Valletta, therefore, we find that the number of bacteria in each c.c., although still small, is sensibly augmented.

The following is the result of numerous experiments with this water taken from a tap in the station hospital, Valletta:

Source of Water.	No. of Experiments.	Average No. of Bacteria per c.c.
Wignacourt Aqueduct, water from tap.	48	562

Valletta is also supplied with an inferior water for flushing purposes, called the Weid el Kbeir water. This, examined in the same way, gives—

Source of Water.	No. of Experiments.	Average No. of Bacteria per c.c.
Weid el Kbeir, water from tap.	13	1315

When we come to count the number of bacteria in water contained in house-tanks, we find a large increase.

I shall first give the results of experiments on the tank-waters of some of the best houses, where every precaution is taken to preserve the purity, and which, on chemical analysis, I considered to be fit for drinking—

Source of Water.	No. of Experiments.	Average No. of Bacteria per c.c.
Tanks, good houses ...	4	25,062

During the present year some slight recrudescence of cholera has been looked for by the Maltese authorities. As it would be most interesting to demonstrate the presence of Koch's comma bacillus in the tank-water of houses where cases might occur, Sir W. Hely-Hutchinson, the Lieutenant-Governor, most courteously promised that samples from such tanks would be forwarded to me for examination. A suspicious case did occur at Birchircara, the tank-water of which, although not showing Koch's comma bacillus, was found to contain a very large number of other forms of bacteria—

Source of Water.	No. of Experiments.	Average No. of Bacteria per c.c.
Foul tank, Birchircara ...	4	500,000

Lastly, I would give the result of the examination of three tanks in Zabbar. The first two were considered by the inhabitants of the houses to contain very good water; the third was looked upon as being bad, and it certainly looked it, being of a sherry colour, and smelling badly.

Source of Water.	No. of Experiments.	Average No. of Bacteria per c.c.
Tank, Zabbar	4	140,000
„ „	4	250,000
„ „	4	1,760,000

Before quitting this subject, it may be interesting to note that, among the many kinds of bacteria isolated from these drinking-waters, there were three species closely resembling the spirillum of cholera. On drawings of these species being sent to Dr. Koch, he wrote that they were quite new to him. Although all three liquefy gelatine in common with the cholera spirillum, there are marked differences in their mode of growth; and none of them show the red colour on addition of concentrated sulphuric acid, which is a characteristic reaction of the supposed cholera microbe.

Let us now turn our attention to the removal of sewage in Malta.

As in treating of the water-supply, I shall begin with Valletta, Floriana, and the three cities.

For the removal of sewage from these cities a complete and costly system of drainage by water-carriage has been carried out during the last few years. In the year 1865, at the time of the former epidemic, the drainage was effected by means of narrow channels cut in the porous sandstone, which conveyed, or failed to convey, the sewage into the harbours. The new main drain conveys the sewage by a circuitous route, several miles in length, and pours it into the sea at some distance from the mouth of the Grand Harbour. In the report on the Cholera Commission by the sub-committee on re-drainage, it appears that the street-sewers were found on inspection to be practically clean, that the gradients were sufficient to give a rapid flow, and the flushing apparatus worked efficiently. But the condition of the house-drains was less satisfactory. In almost every instance there was strong evidence of stagnation within the house-drains. The sub-committee satisfied themselves of this, in several instances, by pouring water down the drain and observing the putrid sewage which came out with the first flow. The sewage-flow seen in the street-sewers was black and putrid even close to the heads, giving further evidence of stagnation in the house-drains.

This defective action of the house-drainage is attributed to defective construction, principally as regards workmanship, and improper usage on the part of the occupiers.

From this it would appear that although a great advance has been made in the drainage of the fortified cities there still remains much to be done.

In the villages there are two methods of getting rid of the sewage. One is by pouring it into cesspools in the vicinity of the houses; the other, by throwing it into one of the rooms of the dwelling, which receives the name of manure-

room. In the central set of villages the sewage is as a rule got rid of by the cesspool system. By law these houses should be drained into separate water-tight cesspools in the street. But this would entail the trouble of frequent emptying, so the builder, taking advantage of the numerous fissures in the porous sandstone, takes care that the cesspool will communicate with one of them. Mr. Osbert Chadwick, C.E., in a memorandum on drainage, states that these cesspools may be cemented to the satisfaction of the sanitary inspector, but as soon as he is gone a few blows of a pick-axe suffice to make a leak. Many of these cesspools have never been emptied since they were made, the contents slowly leaking into the porous rock. As may well be imagined, this is a fruitful source of contamination to neighbouring wells. But the manure-room is the most transcendent abomination. This obtains, as was pointed out in a previous part of this paper, in most of the poorer villages, such as Zabbar, Zeitun, and those lying towards the eastern end of the island, where manure is valuable for use in the neighbouring fields. In this room, close to the living-rooms and pent up by the enclosing walls, all the filth and refuse of the family and animals are stored. This hoard is increased by the daily addition of dung scraped up from the streets or roads by the younger members of the family.

From what has already been noted, it is evident that the sanitary condition of Malta, as regards drinking-water and drainage, is mostly in a very barbarous condition, but as regards the most densely peopled part of the island, viz., Valletta and the three cities, a very great deal has been done within the last few years. These cities, from being among the worst drained and worst watered of Mediterranean cities, are now amongst the best. But in regard to overcrowding in the fortified cities, the condition is becoming daily worse. In the report of the Cholera Commission it is stated "that the fortified cities, and even some parts of the villages of Malta, are overcrowded to an extent that is dangerous to public health. Many blocks of houses exist so closely packed together that it is impossible to secure the proper amount of light and air. The general arrangements of the existing villages, as we have seen, is highly insanitary. From the narrow and tortuous streets lanes branch off which are even narrower and more irregular. These are the only means of access to the densely built-over quarters, and they often terminate in blind ends. There is, therefore, an inadequate supply both of light and air."

The quarter called the Manduaggio in Valetta is pointed

out as being one of the principal places most unfit for habitation. The immense overcrowding of this quarter was touched upon in a previous part of this paper.

From the foregoing considerations, Malta, from a sanitary point of view, cannot be considered cholera proof. The Government, recognising this, and acting on the hypothesis that cholera is always imported into the island from without, have for many years been in the habit of imposing stringent quarantine regulations on vessels coming from infected ports. Latterly the tendency has been to "sfratto", or stop all communication whatever with these infected places, as the danger of allowing persons to pass from ten to twenty-one days in an overcrowded and unhealthy lazaretto became manifest; and further, in order to prevent an ingress of people from cholera-stricken ports by roundabout ways, each person has been required to produce a certificate from the British Consul at the port of embarkation, to the effect that he had not been in any infected district for twenty-one days. It need hardly be said that in practice this is largely evaded.

Another weakness in this system of quarantine is the impossibility of gaining early information of the occurrence of cholera in a given place. The Malta Government depends for this information on H.M. consular agents, who again depend mostly on the local authorities. It cannot be expected that these local authorities will be prompt to declare an outbreak in their town or district, but rather that they will hesitate as long as possible. Because it must be distinctly borne in mind that quarantine regulations do not interfere so very much with the trade and commerce of the place imposing them. Trade went on briskly enough, and there was plenty of employment for the very numerous class of persons engaged in the harbours of Malta, from 1883 to 1886, but on cholera breaking out in 1887 the place became a desert, and thousands of these people had to depend on public or private charity for subsistence.

Malta is physically well adapted for the carrying out of strict quarantine. Most of the south coast is bounded by lofty cliffs, and the landing-places on the north side are few in number. No vessel can approach the island, except at night, without being seen from one or other of the observing stations. But, in spite of her advantages, Malta has not remained free from epidemics of cholera, as will be seen from the following table, which gives an epitome of epidemics since 1837, in which year, as stated by Dr. Ghio, cholera first appeared in this island:

Year.	Date of first Case.	Date of last Case.	No. of Days' Duration.	No. of Cases.	No. of Deaths.
1837	9th June	11th October	117	8617	4071
1850	9th June	13th October	125	4029	1738
1865	9th June	11th November	155	2362	1479
1867	5th July	25th November	143	403	259
1887	25th July	11th November	110	759	463

The neighbouring island of Gozo was attacked in the course of the first three of these epidemics, but escaped the last two, although there was unrestricted intercourse between the two islands, and the sanitary condition of Gozo is worse even than Malta in some ways, although not so densely populated.

The only fact regarding quarantine, which may be considered to relate to the introduction of cholera into Malta in 1887, is that the rigid "sfratto", which had been imposed against Sicily for several months at the beginning of the year, was taken off on the 18th May, on the representation of the local authorities that the cases of the disease had ceased. This "sfratto" was not reimposed until the 4th July, when another outbreak of the disease took place in Sicily.

Putting aside the improbability of cholera ceasing in Sicily at such a date as the 18th May, it is now well known that many cases of the disease occurred during this interval, and were returned by the authorities as gastro-enteritis.

It seems to be the common belief in Malta that the cholera obtained entrance during this period of unrestricted intercourse with Sicily. And an attempt was made by Dr. Grech, one of the medical men examined before the Cholera Commission, to point out the ship by which it was conveyed. The story told by him was to the effect that a ship-chandler, living in Cospicua, dined on board an Italian steamer at anchor in the Grand Harbour, about the beginning of July, and was afterwards seized with violent purging and vomiting of a choleraic type, which, however, did not prove fatal. On the 9th July, Dr. Grech reported the case as being of a suspicious character, detailed the symptoms observed, and the employment and connection of his patient with the Italian mail-packets that were in free communication with Sicily, where cholera was raging.

The Cholera Commission came to the conclusion that there was no evidence of this having been a case of true cholera, or that there had been any spread of the disease from this man or his family; and it may, at this point, be stated shortly, that the attempt made by the Commission to discover the

date or manner of the introduction of the disease failed altogether.

At the same time, from what has been said, it will be granted that, if the disease is capable of being conveyed in a bundle of dirty linen, or in the intestine of a man suffering from what seems to be a simple diarrhœa, there was abundant opportunity of its gaining access to the island; and the impossibility of keeping it out, by any practical system of quarantine, will also be apparent.

But quarantine, although useless for its main purpose, and as the cause of an infinite amount of discomfort, is necessary in Malta, for at least two reasons: First, to prevent the ingress of crowds of poor, terror-stricken people from infected places into an already overcrowded island; and, secondly, to prevent Malta being quarantined by healthy ports.

Let us now turn for a moment to the subject of cholera in the countries bordering on the Mediterranean, for some years prior to the epidemic in Malta. In 1883 the disease was epidemic in Egypt. In the following year it became widely spread; the ports of the south of France, the east of Spain, the north of Italy, and Naples being the main points of attack. In 1885 a great epidemic swept over Spain, Marseilles, Toulon, and the north of Italy again suffered, and the disease appeared in the north of Sicily; 1886 found the disease in Sicily, Sardinia, and the south of Italy; and, lastly, in 1887, it again appeared in Sicily and the south of Italy, and the first officially notified case broke out in Malta, in the village of Zabbar, on the 25th July.

To the best of my belief, no cases of undoubted cholera occurred in Malta during the years prior to 1887, when cholera was epidemic in the Mediterranean. Why cholera failed to become epidemic in these years is an impossible problem. There was nothing noticeable in the meteorological condition of 1887, and the general health of the troops and civil population was better than in previous years.

Death-rate in Malta of the Civil Population from all Causes.
Ratio per 1,000.

Year.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Per 1000 ...	26	24.5	29	27	25	24.5	26	37	26	31

The high death-rate in 1885 was principally due to a high mortality among young children, following, I am informed, on an epidemic of measles, and no doubt aided by the excessive

heat, and consequent unhealthiness of the summer of that year.

The disease cropped up here and there in different parts of the island, in such a way as to make it difficult to believe that it was spread by human intercourse. Bearing on the same point, I may quote the Cholera Commission, who state in their report that no positive evidence of the transportation of the disease by human intercourse has been obtained, nor, indeed, has any information been elicited as to the manner of dissemination in general.

Until the entity, if such a thing exists, which causes cholera is known, and its properties understood, it seems useless to attempt to explain the spread of the disease. Let us, however, for a moment, take up the most modern hypothesis as to the causation of cholera, viz., that it is caused by the entrance into the body of Koch's spirillum. For this we have the high authority of De Bary, who states that: "According to the facts as at present known, there can scarcely be a doubt that Koch's spirillum is really the contagium vivum of Asiatic cholera. First of all, its constant presence—for we may call it constant—in the small intestine or in the evacuations of cholera-patients is acknowledged by all observers, even by those who do not accept Koch's views." And, again, "Koch's spirillum has never been found either in the intestinal canal or in any other part of the body in any disease except Asiatic cholera." A few observations of my own on this point agree with De Bary's statement.

It will be remembered that one English soldier died of cholera during last year's epidemic in Malta. This was the only opportunity I had of making a *post-mortem* examination soon after death. From the contents of the ileum Koch's comma bacillus was readily cultivated; in fact, the fluid contained in the intestines was seen under the microscope to be almost a pure cultivation.

After the cessation of the epidemic, a very suspicious case occurred in the same military hospital. A sample of the dejection, closely resembling the rice-water stool of cholera, was sent to me for examination, but from it I failed to obtain the cholera microbe. Afterwards this case was found to be due to acute milk-poisoning. In the same way I have, during the present year, examined several severe cases of vomiting and purging, which aroused suspicion in this and other military hospitals, but with the same negative result. These cholera spirilla, when introduced into sewage-contaminated water, such as is found in most of the tanks of the Maltese towns and villages, will multiply a million-fold in the course

of a few hours. Again, from experiments conducted by Koch himself, it was found that it was only in certain conditions of the stomach and intestines, such as alkalinity, condition of irritation, etc., that he could succeed in infecting animals.

This difficulty of finding a fitting post for the rapid vegetation of the parasite, would explain the great number of houses in which only one death occurred. The cholera-germ might be looked upon as an intricate key which requires a complicated system of tumblers in the human lock before it could act. Now, let us suppose a single individual has the disease, and he deposits myriads of these spirilla by the road-side, on linen, etc. On any of the perfectly calm, excessively hot days which are common during summer in Malta, if one takes a position on a height, he will see numerous examples of the phenomena known in India under the name of "devils". These are local disturbances of the air, in the form of violent eddies, which pass along the surface of the ground, whirling up dust, leaves, pieces of paper, etc., which form a narrow column, some hundreds of feet in height, resembling a narrow column of smoke. This drifts slowly over the plain, and deposits the matter caught up over a large area. It is conceivable that by this and other similar means the virus of a disease might be carried hither and thither, finding, here and there, a suitable nidus for rapid multiplication.

The villages of Malta, as a rule, escaped lightly in 1887 as compared with 1865. But there are some exceptions to this rule—*e.g.*, Zabbar and Zeitun, whose sanitary condition we found to be so bad, were struck more heavily in 1887 than in 1865. Dr. Inglott, the police physician at Zabbar, took very careful notes of the first cases, and from him I learn the following facts.

The first case, viz., Luigi Bonnici, was attacked early in the morning of the 25th July, and died at 4 P.M. the same day. This young man lived in one of the most unhealthy and overcrowded buildings in Zabbar, which afterwards supplied other two cases of cholera. I examined the house, and found it to be a small two-storied house built round a court-yard, and inhabited by seven families. Most of the rooms were dark and dirty dens. This man, Bonnici, was not employed in the Grand Harbour, but fished at Marsa Scala, a few miles to the east. These fishermen, it is said, often go out many miles from shore, and meet Sicilian boats for the purpose of procuring cheap spirits and wines. It may be interesting to note that the said Luigi Bonnici had the reputation of being rather active in this contraband trade.

After a lapse of four days the second case occurred in Zabbar—Carmelo Delia—also a fisherman. This man's house is situated quite half a mile from that in which the first case occurred, and there is no certain history of contact. But, at the same time, it is curious to learn that this man and Bonnici were companions, and both fished at Marsa Scala.

On the same day Concitta Debono was attacked. This old woman lived in the same house as Bonnici. She was extremely poor, and lived in a dark, damp room. According to her own account, she had had no food for thirty hours, until two hours before the attack began.

Carmelo Bonnici, the brother of the first case, was next attacked. He lived in the same room in which his brother had died, and which I described as being in an unhealthy and overcrowded lodging-house at Kerroza.

All the cases at Zabbar occurred among the very poor, with the exception of two, who were in easy circumstances. The one, a shopkeeper, had suffered for some time from diarrhœa, which he neglected; and the other, an old woman, is reputed to have nursed a sister with acute diarrhœa, and was up all night assisting her before she herself was taken ill.

The lunatic asylum, which stands isolated in the country, and which is here treated as a small village, escaped altogether in 1865, although cholera was introduced by a visitor. In 1887 there is no history of introduction, but nineteen deaths occurred. This asylum was built for 250, but during 1887 contained a population of 460. On this outbreak occurring, a sanitary inspection was made, which revealed a foul and offensive condition of the drains. So that overcrowding and insanitary surroundings existed in this public institution.

It will be remembered that, in speaking of the sanitary condition of Malta at the time of the last epidemic, the cities and villages were grouped in three categories, viz.:—

1st. The five cities, in which there was a constant water-supply under pressure, and good system of drainage.

2nd. The central group of villages to which good water was supplied, but this was stored in underground tanks. Drainage into cesspools.

3rd. The eastern group, which depended for their supply on rain-water collected from roofs, courtyards, and streets. Removal of excreta into cesspools, or by storing it in a manure-room.

These three groups give the following numbers of deaths per 1,000:

1st group	...	...	1.81
2nd „	...	...	2.42
3rd „	...	...	5.57

This may be a mere coincidence, but probably the sanitary condition of these places plays some part.

Let us now bring before your attention some statistics of the cholera-epidemic under consideration. According to the last census, taken on the 3rd April 1881 by Dr. George Cousin, the population of Malta was 132,129; at the same time the population of Gozo was 17,620; and Comino, 33.

Dr. Cousin has kindly sent me the estimated civil population of these islands for 31st December 1887. It is as follows:—Malta, 141,632; Gozo and Comino, 19,047. The average military population for 1887 was: Officers and men, 6,059; women, 263; children, 519.

The 1887 epidemic of cholera was almost altogether confined to the civil population of Malta. The neighbouring island of Gozo may be said to have totally escaped, as only one case occurred there, in the person of an old woman aged 71, who was attacked at Rabato, Gozo, shortly after her arrival from Cospicua, Malta. This one case recovered, and there was no further spread of the disease. Among the English troops there was only one case. This soldier was a private in a detachment of the Essex regiment, quartered in the unhealthy barracks in Singlia. There was also one case among the Royal Malta Fencible Artillery; and, lastly, a case among the Marines on board H.M.S. *Hibernia*, anchored in the Grand Harbour. These three cases proved fatal.

The first case of cholera, according to the official list, which occurred among the civil population of Malta during the epidemic of 1887, was on the 25th July, at Zabbar; and the last case was at Misida, on the 11th November. The epidemic lasted, therefore, 110 days, and during this time there were in all 763 cases and 466 deaths. Putting this in a tabular form, we have—

Malta—Civil population,	759 cases;	463 deaths (61 per cent.).	
Soldiers ...	1 case	1 death	
Marines ...	1 „	1 „	
Gozo—Civil population	1 „	0 „	

We may, therefore, leave out of consideration the military and naval population of Malta, and also the civil population of Gozo, and concentrate our attention on the civil population of Malta.

As the civil population of Malta, on the 31st December

1887, was 141,632, it follows that there were 5.36 attacks and 3.27 deaths per 1,000 of the population. This gives the large death-rate, to cases treated, of 61 per cent.

Some explanation of this high death-rate to the cases treated may be afforded by the fact that the class of population among whom the cases principally occurred were much averse to the compulsory removal of their sick to the cholera hospitals, practised by the authorities during the epidemic, and this undoubtedly led to the concealment of many of the milder cases.

From statistical tables, where the sexes and ages of all persons attacked are shown, it has been ascertained that for every 100 males attacked by this disease, there were attacked 108.77 females. But, in 1887, there were 70,155 males in Malta, and 71,477 females. Reducing the above numbers to the ratio per 1,000, it gives 5.16 per mille for the males, and the slightly higher proportion of 5.55 per mille for the females.

Another table was compiled giving the sexes and ages of all who died of cholera during the epidemic. This table showed that for every 100 males who died, there died 124.04 females. Reducing this to per mille, we find 2.92 males, 3.60 females. This shows that more females were attacked than males, and also that a much larger proportion of the females succumbed to the disease than did the males. This may be accounted for by the fact of the more sedentary and indoor life of the Maltese women as compared with the men, and the very insanitary condition of most of their homes.

Ages.	Cases.	Deaths.	Deaths per 100.
From 0 to 5 years	50	39	78 per cent.
5 „ 10 „	58	28	48 „
10 „ 15 „	77	21	45 „
15 „ 20 „	41	19	46 „
20 „ 25 „	54	22	41 „
25 „ 30 „	68	35	51 „
30 „ 35 „	80	44	55 „
35 „ 40 „	52	25	48 „
40 „ 45 „	70	46	66 „
45 „ 50 „	18	11	61 „
50 „ 55 „	40	34	85 „
55 „ 60 „	22	16	73 „
60 „ 65 „	55	36	66 „
65 „ 70 „	36	29	86 „
70 „ 75 „	41	35	85 „
75 „ 80 „	18	15	83 „
80 „ 85 „	8	7	87 „
85 „ 90 „	4	4	100 „

The above table shows, generally, that persons attacked at either extreme of life have less chance of recovery than youth or middle age; but, as a matter of fact, infants under one year enjoyed almost a complete immunity.

These are instructive charts, and show the gradual increase of tendency to be attacked by the disease as the age advances. These charts also show the greater tendency to recovery in youth and middle age, as compared with the fatality among the old people, culminating in an equalisation of attacks and deaths among the very aged.

The epidemic spent its force among the poorer part of the population; the largest number of cases, viz., 212, come under the term "Housewoman". Most of these women spent their lives in very unhealthy homes, and were poor and ill-nourished. The men employed about the harbours as boat-men, coalheavers, labourers, etc., furnished 115 cases. It is worthy of note that none of the priests, medical men, or nurses who attended to the sick, succumbed to the disease.

THE SANITARY ADMINISTRATION OF DAIRY FARMS.

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(*Read: December 14th*, 1888.)

THE Sanitary Administration of Dairy Farms was, until recent years, subject to no other legal control than that which aimed at the maintenance of a reasonable standard of cleanliness, which was held to be desirable in the interest of the health of persons who resided on or in the neighbourhood of the premises.

Sanitary negligence, however, in the open country gave no offence to any one. There were no neighbours to complain, and people employed in tending cattle were not themselves likely to find much fault with conditions to which they had been accustomed all their life, and for which they were themselves largely responsible.

Under these circumstances the English dairy farm was allowed to be exempt from much of the supervision which to some extent was being exercised in regard to unwholesome conditions in centres of population. The filth which was permitted to accumulate within and in the neighbourhood of cowsheds could not, it was thought, be accused of inflicting injury upon persons working upon a farm, whose occupation led them to spend the greater part of their time in the open air. Nay, it has indeed been argued that the odours peculiar to premises in this condition were even beneficial to health, and thus, for various reasons, even such lax control as was extended to other places was not permitted to regulate the English farmer's method of conducting this branch of his business.

In large towns, the need for maintenance of a higher standard of cleanliness was sooner recognised, and I may quote the metropolis as one for which a local act, the Metropolis Local Management Act of 1862, made it incumbent on a cowkeeper to obtain annually the licence of the justices of the peace assembled at a special session, in order that he might be able to carry on his trade.

The health of the cow in its relation to the health of the drinkers of her milk was not, however, deemed to be so important as to be deserving of legislative control, nor, indeed, was the milk regarded as being subject to such variations in wholesomeness as to need special protection from unhealthy conditions.

This need came to be understood as the result of investigations, which proved that cows' milk might serve as the disseminator of infectious disease among human beings. It was in 1857 that a member of this Society, Dr. Michael Taylor, first showed that an outbreak of enteric fever was due to this cause, and from that time similar occurrences have been increasingly observed, so many indeed, that in in 1881 Mr. Ernest Hart was able to collect, for the information of the International Medical Congress, the history of fifty outbreaks of enteric fever occurring in this country, and caused by an infected milk-supply.

Dr. Michael Taylor's investigations of the relations between cows' milk and zymotic disease did not end here, for in 1867 he showed that scarlatina might be distributed in the same way, a conclusion which was simultaneously arrived at by Professor Oswald Bell through his investigation of an outbreak of this disease at St. Andrew's. Later, in 1877, Mr. E. L. Jacob traced to a milk-supply an unusual prevalence of diphtheria in Sutton; and Mr. Power showed the same fact the following year in connection with an epidemic of diphtheria in North London. Mr. Hart, in the paper referred to, was able, in 1881, to point to fifteen outbreaks of scarlatina and four of diphtheria due to this cause. The record since 1881 has not been less striking; indeed, since the method of investigating these occurrences has been more generally understood, milk has been constantly and justly incriminated as a cause of zymotic disease in man.

The fact now generally admitted, that cows' milk can spread infectious disease, was not at once accepted. An important trade interest was concerned in this question, and this led not only to an unwillingness to give assent to this new view, but increased the difficulties of investigation. More than this, however, the evidence which could be adduced as to each outbreak was only circumstantial; it could not, indeed, be otherwise, and circumstantial evidence, however exact, is, as such, open to some criticism. But, as year after year passed, the method of investigation of these occurrences came to be more widely understood, and its value as affording the basis for trustworthy conclusions came to be appreciated. At first, actions at law were threatened

against those who had ventured to cast suspicion on particular supplies; but, as outbreak succeeded outbreak, the general proposition was accepted that milk could disseminate certain zymotic diseases, and criticism was properly reserved for the exercise of watchfulness over the evidence adduced in regard to each individual outbreak attributed to this cause.

Finally, the legislature itself recognised this evidence as sufficient to warrant a control over milk-supplies, and in 1878 the Contagious Diseases (Animals) Act was passed.

This Act was a substantial advance upon anything that had gone before. At this moment I do not refer to its imperfections, but desire to point out that it gave the Privy Council power to issue general or special orders for the registration by the local authority of all persons carrying on the trade of cowkeepers, dairymen, or purveyors of milk; for the inspection of cattle in dairies; for prescribing and regulating the lighting, ventilation, cleansing, drainage, and water-supply of dairies and cowsheds; for securing the cleanliness of milk-stores and milk-shops, and of milk-vessels used for containing milk for sale; and, lastly, for prescribing precautions to be taken for protecting milk against infection or contamination; and, further, the local authorities were to be authorised to make regulations for these purposes or any other, subject to such conditions as the Privy Council should prescribe.

The following year the Privy Council issued the Dairies, Cowsheds, and Milkshops Order of 1879, giving important powers to local authorities. First, all premises used for the production or sale of milk were to be registered; this was not required, it will be observed, for the purpose of obtaining the sanction of a local authority to carry on this business, but merely as a means of affording to the authority information as to the premises which required inspection.

Secondly, no dairy or cowshed, not occupied before the making of the Order, could be occupied until provision had been made to the reasonable satisfaction of the local authority, for its lighting, ventilation, cleansing, drainage, and water-supply.

And thirdly, no cowshed or dairy, whether so occupied at the making of the Order or not, was to be occupied so long as the lighting, ventilation, cleansing, drainage, and water-supply were not such as are necessary or proper for the health and good condition of the cattle, for the cleanliness of milk-vessels used therein for containing milk for sale, and for the

protection of the milk therein against infection or contamination.

Cleanliness of dairies, cowsheds, milk-stores, milk-shops, and milk-vessels used for containing food for sale, as a protection against contamination, might be enforced under regulations by the local authority; and risk of milk infection was guarded against by the Order rendering it unlawful for the cowkeeper, dairyman, or purveyor of milk to allow any person suffering from dangerous infectious disorder, or having recently been in contact with a person so suffering, to milk cows, or to handle vessels used for containing milk for sale, or in any way to take part or assist in the conduct of this trade or business, so far as regards the production, distribution, or storage of milk. Further, if a cow were diseased, its milk was not to be mixed with other milk, or sold or used for human food, or sold or used for food of swine or other animals, unless and until it had been boiled. Lastly, the Order made it illegal for any of the above mentioned premises to be used for any purpose incompatible with their cleanliness, or with that of the milk-vessels or milk.

This, then, was the position of legislation until 1885. It will be convenient briefly to review it because upon its sufficiency or insufficiency, more particularly as regards its administration, very much depends the condition of these premises at the present time. It may be pointed out in the first instance that the local authorities responsible for this administration were the justices of the peace, and the inspector, whose duty it was to see that the requirements of the Act and Order were complied with, was the police constable, whose knowledge of the subject matter could not be held to be sufficient for the purpose.

Secondly, the Order made a very wide distinction in its dealings with new and old cowsheds. Cowsheds occupied after the commencement of the Order were under the obligation to meet the reasonable requirements of the local authority for lighting, ventilation, cleansing, drainage, and water-supply, but as regards other cowsheds it was enough that they should be sufficient in these respects for the health of the cattle, the cleanliness of the milk-vessels, and the protection of the milk from contamination.

Now during the eight or nine years since this Order was made not many new cowsheds have been erected. Where an extension of milk production has necessitated more house accommodation for the cows, this has generally been effected by the conversion of old hovels, cart sheds, and barns into cowsheds, and as a result it would require some skill to dis-

tinguish between premises in use before or subsequent to the commencement of the Order. Certainly I shall not be in error if I say that so far as any local supervision has had effect, the first thought appears to have been to decide what is necessary for the cow, and inasmuch as any shelter is recognised in rural districts as sufficient for this animal, the old buildings were not interfered with. Then, in respect of other old buildings not previously occupied as cowsheds, it was obviously unreasonable to expect anything over and above what was necessary for the cow, and thus everything remained much as it was.

In the future we shall perhaps not think very critically of these times. They were years during which the requirements of the bovine animal had been but little considered. They were years, too, of great agricultural depression, and neither landlords nor tenants could well find money for improvements. The best that can be said of them is that they recognised the necessity for farm inspection, and of the right of a local authority to interfere in the public interest.

Even if the law had been fully enforced, there would have remained on many dairy farms circumstances which would have called for improvement. The welfare of the cow in the cowshed only was considered by the Act and the Orders made under it. Her condition in the meadow was not touched by either, and she might here be supplied with water of a kind recognised as totally unfit for her consumption when in the shed. But even there, she was not guarded against circumstances prejudicial to a healthy life. No condition beyond the limits of the shed was touched by the Act and Order. There was no requirement under either for cleanliness in the yard round which the cowsheds are usually situated; this might be unpaved, undrained, and the place of deposit of large accumulations of manure and filth.

The measures for the prevention of milk contamination were based entirely upon the assumption that milk could be infected by human agency, and that the maintenance of cleanliness was sufficient for all other purposes; but even these were faulty, for the Act failed to make it unlawful for the dairyman himself to take part in his business while suffering from infectious disease, or exposed to infection.

The prohibition of the use of milk from diseased cattle was moreover limited in its usefulness, for the word disease had no other meaning than cattle plague, contagious pleuropneumonia, and foot and mouth disease.

In 1885, when a further Dairies, Cowsheds, and Milkshops Order was issued, greater opportunities were given for the

improvement of the conditions of the cowshed. Local authorities were empowered to enforce all the provisions of the Order of 1879, and in addition might require to be satisfied that the air space of the dairy or cowshed was sufficient, and this requirement related both to cowsheds occupied before the commencement of the Order as well as to those not previously occupied. Moreover, with regard to the construction of cowsheds not previously occupied, the occupier was compelled to give one month's notice of his intention to the local authority, thus giving them ample time to inform themselves that the shed was satisfactory.

For the prevention of the contamination of milk, the previous Order was strengthened by making it unlawful for the dairyman or cowkeeper, while suffering from a dangerous infectious disorder, or having recently been in contact with a person so suffering, to milk cows, handle milk vessels, or take part in his business; but there was still no penalty for a servant who acted in this manner, and kept his employer ignorant of his circumstances.

Finally, it became unlawful for any cowkeeper, dairyman, or purveyor of milk, after one month's notice from the local authority, to permit any water-closet, earth-closet, privy, cess-pool, or urinal, to be within, communicate directly with, or ventilate into any dairy or any room used as a milk-store, or shop.

It will be seen by what has already been said that during the last ten years considerable powers have existed for the improvement of cowsheds and dairies, but as a matter of fact they have not been exercised; how far this has been due to the local authorities not being sanitary authorities remains to be seen, but this view has been so strongly entertained that in 1886 the powers relating to condition of premises and to prevention of milk contamination were transferred, by the Contagious Diseases (Animals) Act of that year, to sanitary authorities, and an Order was immediately issued by the Local Government Board empowering them to carry out all the provisions of the Order of 1885.

Since then the position of legislation has remained unchanged, and up to the present it has led to no material change in the condition of dairy farms. Where improvements have been effected, they have resulted rather from the desire of dairymen and others to comply with more modern thought, than from any necessity to fulfil a statutory obligation. The English farmer, however, does not rapidly make changes. Living a more isolated life than the dwellers in towns, he regards his surroundings as affecting himself alone, and the

people he employs are slower than himself to accept more modern views. When, further, a demand for improvement is almost inevitably accompanied by a demand for expenditure, the thought that what was good enough for his father is good enough for him, is almost certain to convince him that he may not unreasonably continue to follow the course which was held to be sufficient a century ago. Of late years certain of the milk-vendors in large towns have themselves felt the necessity of guarding against avoidable risk to milk purchasers. The ruin inflicted on some businesses by outbreaks of infectious disease among the milk-drinkers, moved them to insist upon country farms supplying them with milk having upon them nothing that can contribute to so serious a calamity. Hence under pressure of this kind, some advance has been made, and no doubt many farms are free from objections which previously existed. But the question we may consider this evening is what steps should be taken in our present state of knowledge to prevent injury from milk, and whether the law should be modified to raise all farms to the standard which is held by the more careful of the milk vendors to be necessary to safeguard the milk supplies.

A demand for further legislative interference may not unreasonably meet with the reply that it will be time enough to consider such a need when existing legislation has been utilised to a greater extent than at present. We must bear in mind, however, that the control of milk farms should not be held to be of mere local concern, yet the legislature, in entrusting to local authorities the enforcement of the provisions of the Contagious Diseases (Animals) Acts, has evidently not seen its way to treat this subject in any other manner. Some objection can be taken to this course when it is pointed out that neglect in the condition or administration of a Midland farm finds expression in the deaths of persons resident in London, and London can exercise no control beyond its own area.

On many farms milk is but little, if at all, consumed, and often there is no local distribution of the milk supply. Hence, if the milk acquires the property of communicating enteric fever, the only evidence of this quality is to be found in a large town perhaps a hundred miles or more away. In thinking of this question we may with advantage reflect upon the recent legislation affecting the pollution of rivers. The Local Government Act of the present year so far recognises the fact that the pollution of a river is of more than local moment, as to authorise the Local Government Board to constitute joint committees for its prevention, representing all the administrative

counties through which a river passes. For the same reason London might claim to have a right of interference with the local farm administration of Staffordshire. This is of course impossible, but the very impossibility establishes a claim for sufficient laws and for sufficient observation on the part of a central health department to see that local authorities are not negligent.

With this preface I desire to return to my previous statement that the Act of Parliament, in limiting its operation to the cowsheds and water-supplies thereto, is faulty in an important particular—it takes no cognisance of the circumstances under which the cow is placed in the meadows. Many farms have no better water-supply for the cattle in the fields than ponds filled by land drainage; these ponds in summer are dry or almost dry, and, moreover, the cattle readily pollute the water with their excrement, the pond is cleaned out at uncertain and rare intervals, and it requires no imagination to appreciate the condition to which it is brought.

We have learnt in our study of human diseases to distinguish between risk of excremental and other pollutions of drinking-water, and to appreciate the danger of the former. We may not unfairly lay claim to a water-supply for cows which cannot be contaminated in this manner, yet neither law nor custom step in to limit it. There are farms undoubtedly where an unpolluted water-supply for cattle is considered to be necessary, but speaking generally of English farms, this precaution is neglected.

If it were possible, I would wish to limit the use of ponds for cattle to those which are supplied by springs. If ponds thus charged were fenced round, protected from surface drainage, and provided with troughs in their neighbourhood, and these were filled from the ponds, this contamination would be impossible. How far such a precaution would tend to prevent the infection of milk with enteric fever virus must be matter for mere speculation at the present time; but apart from this, the general proposition should be accepted that the cows' drinking-water should be free from excremental contamination.

The acceptance of this principle is further of importance, because it influences the demand which a local authority should make in reference to drinking-water for the cattle in the cowshed. The authority can require to be reasonably satisfied as to this water in respect of new cowsheds, but in respect of those in occupation before the commencement of the Order, they can only insist that the water shall be such as is necessary or proper for the health and good condition of the cattle.

There is, I fear, too much inclination to think that cattle can maintain health while drinking water which would not be regarded as fit for man; and if I am right in my assertion, we may find, even if the local authority, advised by a medical officer of health, insist on a higher standard, that their decision might not be upheld by the justices before whom a prosecution would be heard. I trust that the veterinary profession, whose opinion on this point is of material value, will endorse the view that this water should be absolutely free from excremental pollution.

Fortunately, the condition of the drinking-water of the cattle in sheds may usually be controlled in other ways. The requirement that water should be provided proper for the cleanliness of milk-vessels, and for the protection of milk therein against infection or contamination, enables water of a sufficiently high standard as to purity to be demanded, for, as a rule, the one well on the premises serves for all these purposes, and, moreover, provides the drinking-water for human beings living on the farm. The Public Health Act for this last purpose can be usefully employed, and if the seventieth section should be interpreted to include water "dangerous" to health, and not limited, as according to some recent decisions, to water which can be proved to be "injurious", the water-supply to cattle in the sheds would be in this manner safeguarded.

The great risk to well-water supplying cattle in sheds arises from the custom of maintaining privy cesspools in the neighbourhood of the well, and from that of depositing the manure on the yard within which, or in the vicinity of which, the well is usually placed. Now the privy cesspool, leaking into the surrounding ground, frequently constitutes a real danger to the well. Chemical analysis would only show when the pollution had absolutely reached the well, and likely enough not even then; whereas, for our purposes, it is necessary to guard against the possibility of such an occurrence. The safest method is, I believe, the complete abolition of the cesspool, and the use of galvanised iron pails beneath the seat, preferably in connexion with dry earth. If this were adopted, and a local authority were empowered to prevent by regulation the burying of the pail contents in too close proximity to the well, one very definite risk would be avoided.

The deposit of manure upon the farmyard near to the cow-sheds and to the well supplying water is, as I have said, highly objectionable, and when this yard is, as in many hundreds of cases, unpaved and undrained, the danger is greatly accentuated. This deposit continues for months

together without any removal being effected, and when it is recollected that a cow makes more than 100 lbs. of manure a day the amount of accumulation can be appreciated. It might be possible to control this custom to some extent by application of the nuisance sections of the Public Health Act; but custom is allowed to give so much approval to this method of disposal of manure, that many an English farmer would resent as absurd an interference with the habit of centuries; and I believe nothing short of its prohibition or control by legislation relating especially to cowsheds and dairies would sufficiently emphasise its importance. The proper course is undoubtedly not only that the yard should be well paved, to prevent soakage from the droppings of animals, but that manure, at the time of removal from the sheds, should be immediately deposited in a suitable vehicle and removed to a spot remote from well and buildings. This entails some increase of labour, but is a concession on the part of the farmer which might be demanded in the interests of the public health. Apart from the Public Health Act, which I am convinced is insufficient for the control of a deep-rooted custom, there is no legal power for such a purpose, the Order made under the Contagious Diseases Act excluding from control any such condition outside the cowshed itself.

The condition of the sheds themselves is undoubtedly matter of importance in relation to the health of cows, and that of the drinkers of their milk. In a paper read before this Society last year, Dr. Ransome of Manchester adduced considerable evidence of coincidences of deaths of human beings from phthisis in particular areas, and in particular houses in those areas. Further, this subject has been carefully considered in connexion with the phthisis rate in the army, and other evidence is forthcoming of certain striking instances of prevalence of tuberculosis of cattle in particular cowsheds. We may claim, therefore, that the manner of housing of cows is proper matter for control, and as a matter of fact the Orders made under the Contagious Diseases (Animals) Act enable local authorities to effect considerable improvement in these structures.

It would be impossible to demand that every existing cowshed should be so altered as to meet a series of precise specified requirements. Each must be dealt with on its own merits, for the manner of construction of cowsheds differs in one part of the country so much from that in another part that the need for special provision for ventilation, for instance, is not the same in each. Speaking generally the cowshed should, properly, be constructed of impervious

material which can be readily washed and lime-whited; the floor should be above the level of the surrounding ground, it should be well paved, with a fall from the head to the feet of the animal, and the drainage should be effected by channels in the floor discharging over trapped gulleys placed immediately outside the walls of the shed. The fittings should be not less impervious than the walls and floor; troughs especially should be of this character, so that absolute cleanliness can be ensured.

One of the conditions which certainly requires regulation, and which cannot be regulated under the existing Orders, is the floor space allotted to each cow. The recent Order of 1885 permits a local authority to regulate ventilation, including cubic space, but as the whole height of the shed can be reckoned into the cubic space, it is impossible even indirectly to control the floor space which should be provided for each animal. For convenience of use and the comfort of the animals the shed, if divided into stalls, should provide for each stall not less than a length of eight feet and a width of four feet, if the stall be for one cow, and a length of eight feet and a width of seven feet, if for two cows. If four feet be added to the measurement of the width of the shed for passage-way, and the shed be sixteen feet high, this would give 768 cubic feet for each cow. This is very much what is required by the regulations of the Metropolitan Board of Works, and is slightly in excess of that recommended by M. Goubaux to the Council of Public Health of the department of the Seine, the exact dimensions, stated by him, being 1·60 mètres for the width of each stall, and a total air space of twenty cubic mètres, or 706 cubic feet, for each cow. There are practical reasons for limiting the width of the stall which deserve consideration. Cow-keepers indeed object to a greater width for the reason that it gives opportunity for the cow to turn round and foul her feeding-trough.

The question of ventilation is necessarily considered in connexion with that of warming, and the greatest diversity of opinion exists among farmers as to the requirements of the cow in this respect. In some farms in the Midland Counties, the animals are left in the fields night as well as day, winter as well as summer, and are only brought to the sheds for the purpose of being milked. In others, they are in winter housed in open hovels, having but one wall and a roof; in others, again, the hovels are closed in winters with hurdles; and in other farms it is thought necessary to maintain them in an atmosphere of a temperature of 55° to 60° Fahr. It is generally accepted that the quantity of milk is

affected by the temperature at which the animal is kept, and that often this is forced with the object of increasing the supply. I believe that the most trustworthy advisers are satisfied with a temperature of about 50°; on this point I may quote the opinion of Mr. George Barham, whose experience is of great value, and who stated at a meeting of the Society of Medical Officers of Health that this temperature is more conducive to the health of the animal.

Assuming, as we may, that this is sufficient, we see that it gives scope for the introduction of fresh air even in cold weather without lowering to too great extent the temperature of the shed, and without resorting to artificial warmth. There is of course need of precise enquiry to show the extent to which the cow vitiates the air she breathes. In the absence of definite knowledge on this subject, it is impossible to do more than judge by the ordinary senses. Experience of this kind shows that permanent openings should be provided on both sides of the shed beneath the eaves, and louvres should be placed in the roof; a constant current would thus be maintained above the animals in a position which would not chill them. Opposite windows in the walls, which could be open or shut at pleasure, would enable this air to be supplemented.

It is somewhat curious that the cow which in the summer lived in broad daylight in the meadows, is often in the winter confined in a dark shed. Abundance of light is an essential to cleanliness, and is doubtless needed in the health interest of the cow herself. There does not appear to be any reason why the house of the bovine should be less well lighted than that of the human animal.

Before leaving the subject of the cowshed, I may add a few words as to its position and size. I am dwelling to-night especially on country cowsheds, and the demand for air space around them does not therefore present itself as urgent, but it is deserving of note that the Contagious Diseases (Animals) Act gives no control on this point. In large towns, such as the metropolis, the conditions are different, and I may state briefly that the law now permits the occupation of cowsheds so hemmed in with other buildings that ventilation, in the true sense of the word, is an impossibility, and so situated that there can be no proper place for the deposit of the manure which is produced; in London, licensing justices should exercise a careful discretion as to the premises which come in this category. In referring to the size of the cowshed, it may be observed there is considerable advantage in limiting the number of cows which can be placed together in the same

shed; their sub-divisions into smaller groups than are occasionally to be found in some buildings, would tend to lessen the probability of extension of any infectious disease if introduced among them.

I now come to the question of milk contamination and its prevention, a subject which is of the utmost importance to the public, and which is now engaging the attention of two departments of the State.

It will be seen that the legislation which at present exists, is based upon the theory that milk infection occurs after the milk has left the cow, and as the result of human agency. The precautions, which can be enforced by law, are such as appear to be reasonable with this view, except that they require amendment in the points indicated. One other difficulty has to be cleared away; the word "contact" has on one occasion been held to mean actual contact; the instance to which I refer is that of a man and his wife who kept a milk-shop, and who nursed their child suffering from scarlet-fever, while the father attended to his own business. The father was constantly with the child, but actual contact with it could not be proved, and the prosecution broke down. The case was not, I believe, heard on appeal, but this point is worth considering when the Order comes to be amended for other reasons.

But the question seriously arises whether precautions of this kind are enough to protect milk against infection; whether, indeed, the cow herself can suffer from some malady which may give rise to milk-infection. If I understand aright the position of those who are contesting the conclusions based upon Mr. Power's and Dr. Klein's observations, it is not to deny the possibility of such an occurrence, but to regard the evidence as insufficient to afford material proof; and, further, the argument is used, that milk-contamination by human agency has not been entirely excluded so as to negative all possibility of such an occurrence having given rise to the circumstances which came before Mr. Power. Upon this point every one must form his own opinion, and I may, without entering upon a discussion of the arguments which have been adduced, limit myself to the statement that at the present time we are without any precise knowledge that milk, which has given rise to infectious disease in man, has ever obtained this power from contact with human contagium. The belief that milk-infection has arisen in this way has been accepted for the reason that, in the absence of other explanation, it coincides with a general sentiment as to the behaviour of contagium.

If I might mention my own experience on this point, I could tell of a public institution containing wards, some of which contained patients suffering from scarlet-fever, and some of which contained patients suffering from other maladies. At one time the milk for the latter was actually carried through the scarlet-fever ward in an open can; and even after an alteration in the arrangements of the institution led to the cessation of this practice, the milk for the non-scarlatinal patients was for years daily measured out of a large can by a nurse intimately engaged in the nursing of scarlet-fever patients, not one or two, but usually from thirty to forty, and these in all stages of the disease; and yet no evidence is forthcoming that injury resulted from this exposure. This evidence is obviously negative, and as such carries less weight than positive evidence; but the constant repetition of the experiment day by day entitles it to serious consideration. There is, however, one difference between the milk at this institution and that on a farm: the former is always cold, and on the farm, at any rate for some period of time, warm; and it might be pleaded that in this difference rested the freedom from contamination of the milk of the institution. Without admitting the sufficiency of this argument, further evidence may be adduced as to farms which have undoubtedly had infectious persons resident in the farmhouse, the occupants of which have been employed in the cowshed, and yet again without any evidence of influence on the milk. Although not wishing, in the state of our present knowledge, to give approval to neglect of the precautions which the Order of 1885 prescribes, I am unable, in the light of this experience, to find adequate explanation of the daily infection of milk in the visits to a farm of a lad dwelling in a house with a case of scarlet-fever, but not himself suffering from the disease. This, however, is the only evidence of contamination by human agency which has been put forward in respect of the Hendon outbreak, now the subject of much discussion, and is illustrative of the kind of evidence which has been before regarded as an explanation of similar occurrences.

Exact medical knowledge, I would venture to say, does not warrant us in attributing milk-infection to human agency more than to cow-malady; yet the one theory of infection is recognised by the legislature, and the other is not. Stringent precautions, I consider, should be taken for the exclusion of both possibilities, and the administration of the dairy-farm should be so ordered as to protect the cattle against communicable disease. The dairy-farmer can do

more than at present is done in regard to this. He should certainly not place among the rest of his herd any newly purchased animal until it has been submitted to a careful quarantine of a month, and his premises should be arranged so as to afford facilities for such isolation. This quarantining should extend not only to the separation of the cattle, but to arrangements being made for the milking of those in quarantine by a person not employed for the milking of the others; and, lastly, only after careful inspection should this period of quarantine be declared at an end. Again, if communicable udder disease should appear in any animal in the general sheds, it should be isolated, and the same precautions taken in regard to it as are held to be necessary for animals newly purchased.

By one small detail the dairy farmer can do much to prevent the infection of others of his herd if any one of them should come, in spite of his care, to suffer from communicable udder disease. If the milker would adopt the habit of washing his hands after the milking of each cow, the probabilities of conveyance of infection from one cow to another would be enormously diminished; for there is no doubt that the milkers' hands are the usual means by which the infection is carried. In claiming that this rule should be observed on every English dairy farm, I am doing little more than asking that Englishmen should not be less negligent than Danes. In Denmark the rule is to wash after the milking of every two cows; and already, I am glad to say, on some English farms the practice of handwashing after the milking of each cow is now adopted. The results, I am told by those who take this precaution, have been entirely satisfactory; and though it has not prevented the occasional appearance of this form of malady on an individual cow, its extension to the rest of the herd has been limited in a marked degree. The amount of trouble this habit of cleanliness would entail upon the milker would be as nothing compared with the ample return it would make to the farmer in the increased healthiness of his stock.

For the purposes of legislative control, it may be said that communicable udder disease of the cow, whatever its form, renders her milk unfit for the supply of food for man. On this point, I am able to quote no less an authority than Professor Brown, whose remarks at a recent meeting of the Pathological Society, I would beg to reproduce. Speaking of a disease of this kind which had been prevalent in Wiltshire, he said, "Whatever the disease really might be, it was at least certain that the milk of cows suffering from

it was contaminated with pus and other morbid products, which might very well be responsible for human disease—for infantile diarrhœa, for instance." The condition in which milk sometimes was, might be gathered from a remark made by the dairymen on one farm, which was to the effect that "they could not drink the milk themselves, and had sent it to London, but they hoped the poor people there would not suffer." Accepting this conclusion, we may hope to see an Order issued which shall extend to this form of cow malady the same restrictions which are now required in regard to the milk of cows suffering from certain specified diseases. Under these circumstances an outbreak would be notified to the justices, and would be brought under veterinary inspection, and, not less important, the milk would not be sold, or used for human food. Professor Brown himself encouraged this hope, and expressed the opinion that it was most necessary to bring the Wiltshire disease under the Contagious Diseases (Animals) Act, and he further said, he had drafted an Order which would have the effect of compelling owners to report the existence of the disease, and would render it possible to isolate the animals. I assume, for practical purposes, he would include, under the word "disease", all communicable udder diseases which can affect the milk in the manner he describes; and lastly, I would claim, in view of the possibility of risk to man, that tuberculosis should be dealt with in the same manner.

As part of the system of cleanliness thought to be necessary for the prevention of the contamination of milk, the maintenance of cleanliness in the cow herself ought not to be omitted. No one who is conversant with English farm life can fail to be struck with the contrast between the precautions which have been urged as to the exclusion of drain inlets from dairies, and other similar provisions, and the omission to require the least observance of any rule to prevent pollution of the milk by the cow's excrement at the time of milking. The teats and udder constantly become fouled by the evacuations of the animal, and yet the washings of these parts of the cow is in many instances thought to be a work of supererogation.

Whether infected milk, during the period which elapses between its removal from a farm and its consumption by the milk-drinkers, increasingly acquires a power of infectivity is not definitely known; but I have been impressed on more than one occasion with the limited effect such milk has had upon the drinkers resident upon the farm compared with that which it has produced upon those resident in the

town to which the milk has been sent. No doubt to obtain accurate information on this point it would be necessary to have very precise information as to the number of persons exposed in both localities, and especially the number who are presumably susceptible to the disease in question. If such increase of infectivity does take place, we can well believe that it might find greater opportunity in warm than in cold milk, and on this ground we would urge that milk should be cooled immediately after its removal from the cow. The apparatus for this purpose is effective and inexpensive; but on some farms either the milk is not cooled at all or efforts made in this direction are limited to placing the churn in a pool of water, a very inefficient method of attaining the result desired.

The interval which should be required between the calving of the cow and the use of her milk for food is further matter for consideration in discussing the fitness of milk for consumption by human beings. The condition of an animal which has recently given birth to a calf is such that she is specially susceptible to influences which have less effect upon her later. Her milk, too, is admittedly unfit for use immediately after calving, and sufficient care is not always taken by the farmer to exclude it from the milk churn. Inasmuch as we cannot lay claim to any precise knowledge that would serve as a trustworthy guide on this point, it would probably suffice at the present time to exclude, as unfit for human food, the milk from any cow until a fortnight has elapsed since the birth of her calf.

Regulations made under an Act of Parliament or Order in Council have been permitted to extend to small details of domestic life; as illustration, I may refer to the Model Regulations of the Local Government Board for houses in the metropolis let in lodgings. Where a local authority is judicious in the exercise of these powers, hardship is not inflicted, but the regulations are used more for the purposes of education than for prosecution, and the latter is reserved for cases of flagrant disobedience. I believe, therefore, that the regulation of dairy farm administration, in the sense I have indicated, is both necessary and proper; it need entail no unnecessary hardship on the farmer, and it is certainly urgently required in the interest of the milk-drinker.

If we think of sanitary administration as extending beyond the circumstances I have narrated, it might include some control over the proceedings of a milk farm, the milk of which was alleged to cause disease in man.

In the public interest, it would be right that a local

authority should have the same power to prevent the sale of milk suspected of communicating a dangerous infectious disorder that it has to prevent the continued attendance of pupils at a school believed to be spreading diseases of this kind; and moreover, with a view to enabling the authority to obtain information, it would be right that it should be permitted to know the addresses of persons to whom the milk of a particular farm was supplied. The remedy against injury to the interests of the milk vendor could be found in a system of notification of infectious diseases, such notification rendering unnecessary application at particular houses for information.

One other point of control that should be exercised is that which would prevent the removal from the farm of any cow of a herd the milk of which is suspected to be infectious. Experience has shown this to be necessary; and the interests of other cow-keepers, who might unwittingly purchase such animals, should be protected as well as that of the milk-drinkers. Doubtless such restrictions would be accompanied by proper precautions against an unjust or unnecessary use of these powers.

What is immediately wanted is that the legislation, which is now limited in its application to the cow in her shed, should be extended to cover all the circumstances of her life, whether in the shed or in the meadow, and that her personal cleanliness should be provided for as not less important than that of her house, and further, that some effort should be made to give effect to the provisions of the law. For it is no exaggeration to say that the only sanitary administration in many districts in respect of dairy farms at the present time, which is worth the name, is that which has been created at the instance of certain milk vendors in large towns who have been desirous of protecting the customers they supply.

Again, the recognition that other diseases than those specified under the Act of Parliament have effect upon the milk, is a step which would bring upon the scene the veterinary inspector, whose active co-operation is urgently needed for the prevention of disease in man.

SCARLATINA IN ITS RELATION TO COW'S MILK, AT WIMBLEDON AND MERTON, 1886-7.

By C. H. COOPER, A.M.I.C.E.

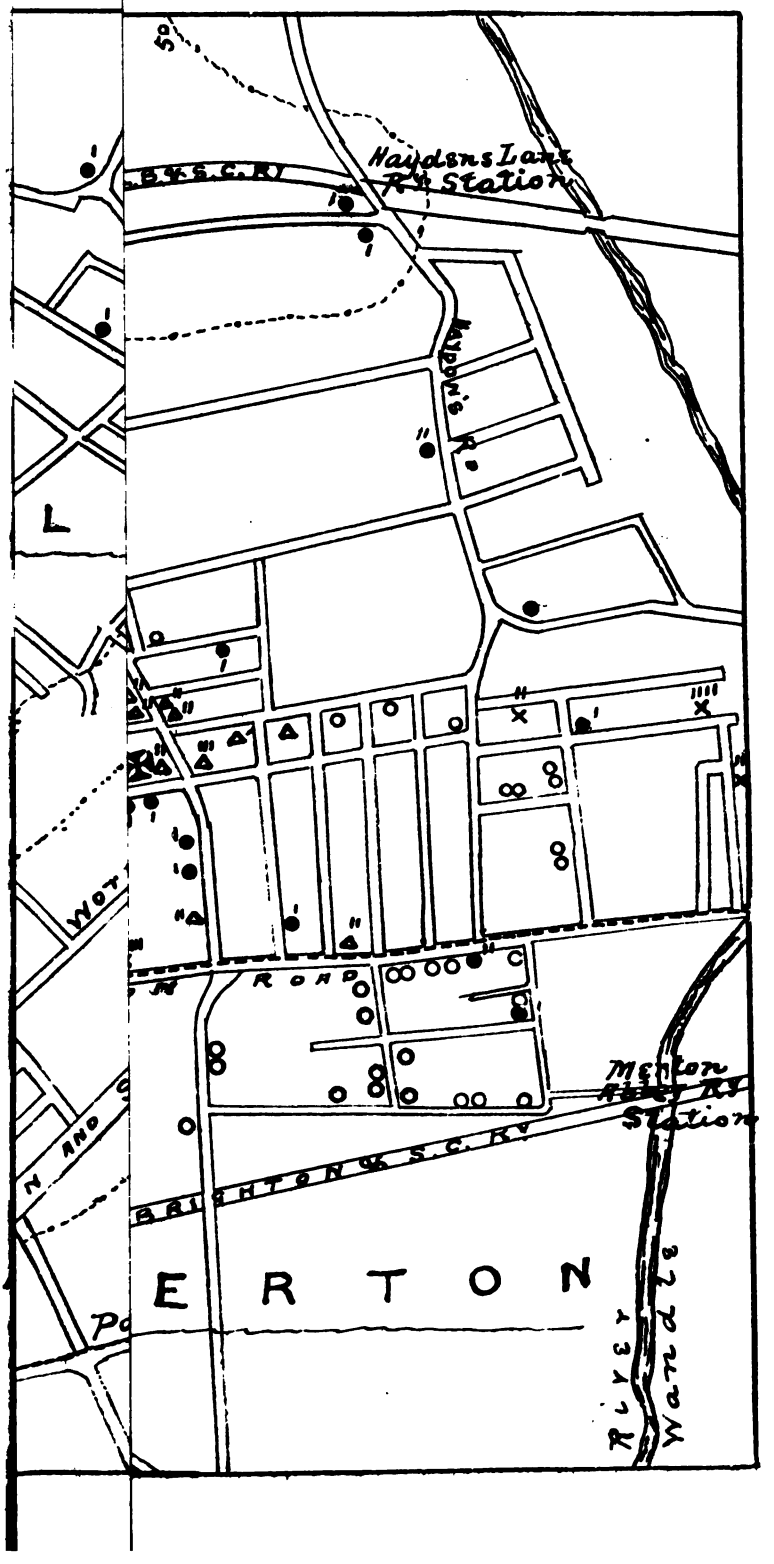
(*Read: December 12th*, 1888.)

District Invaded.—During the last week of December 1886 and the first week of January 1887, 592 cases of scarlatina and similar throat-illness occurred amongst the inhabitants of a district comprising portions of Wimbledon and Merton. The district thus invaded was supplied by the same water-companies, and drained by the same sewers as those portions of the suburbs that remained free from epidemic. So that neither the water-supply, drainage, nor density of population seems to have had the slightest influence on the spread of infection.

Milk Supply.—The one thing common to those attacked was that, with few exceptions, all were consumers of milk from the same dairy, designated herein No. 1 milk.

The dairy that supplied the whole of this milk, and the farm where the same was produced, are both situated in Merton. At neither place was any sanitary defect of importance discovered. At the farm forty-one cows were kept housed in lofty and well-ventilated sheds. To the casual observer these animals appeared in good health, a fact that was verified by the veterinary inspector of the district, who examined all the cows immediately after the epidemic broke out, and gave a certificate, saying that "all the animals were in a healthy condition".

Contemporaneously with the general outbreak, but not in any way preceding it, cases of scarlatina occurred at the farmer's house and at the dairy. Dr. Rocklington, the medical officer for Wimbledon, immediately on becoming aware of these cases, and those of other consumers of No. 1 milk, stopped the milk being distributed in Wimbledon after the morning delivery of December 31, and to this promptitude of action the sudden subsidence of the epidemic was no doubt due.


Haydens Lane Rly Station
B & S.C.R.
Haydens Rd
L
WOT
ROAD
Merton Abbey Rly Station
BRIGHTON & S.C. Rly
E R T O N
River Wandle

Law.—It is of no little importance that the action thus taken by the medical officer for Wimbledon does not appear to find its justification in any legal enactment.

Section 126 (3) Public Health Act, 1875, prohibits the giving, lending, selling, transmitting, or exposing, without previous disinfection, any bedding, clothing, rags, or "other things" which have been exposed to infection from any dangerous infectious disorder. If the words "other things" in this section are construed "inter alia", the section does not include food.

Section 117 of the same Act gives power to a justice to order that certain kinds of food, including milk that may have been seized by a medical officer or Inspector of Nuisances, as diseased, or unsound, or unwholesome, or unfit for the food of man, may be destroyed. This section is quite unworkable in such a case as that of No. 1 milk, for, assuming that the Wimbledon authority had seized, on a particular occasion, the twenty barn-gallons of the infected milk that entered their district every morning by four different walks, and the thirteen barn-gallons that similarly entered the district every afternoon, and had conveyed the milk to the police-court, in view of getting it condemned by the presiding justice, what chance of success would the Authority have had? The farmer could produce the veterinary inspector's certificate that the cows were healthy, and could show that the case of scarlatina that occurred at his house had no connection with the cowsheds. The retailer could prove that the greater part of his milk was delivered direct from the farm to his customers; the milk itself appeared good; so that unless a bacteriologist could discover the existence of the streptococcus of the Hendon cow disease, it was not likely that any conclusive evidence would be forthcoming against the wholesomeness of the particular milk that had been seized.

Even if the streptococcus of the Hendon cow disease had been discovered, it is a matter of great doubt if the justice would have condemned the milk or not, since medical men and veterinary surgeons could be represented as at variance regarding the existence of such a disease.

The Dairies, Cowsheds, and Milk-shop Order of 1885 makes provision to prevent the milk of diseased cows being sold or used for human food, but the word disease in this Order has the same meaning as in the Contagious Diseases (Animals) Act, 1878, section 5, and thus includes only cattle-plague, pleuro-pneumonia, and foot-and-mouth disease.

The writer is of opinion that the Government should organize research into the connection between animal and human maladies, so as to determine how far the existence of disease in animals whose flesh, milk, or eggs are used for food, may be injurious to persons who consume the same. Where risk of injury is liable to arise from animal maladies, power should be given to Sanitary Authorities to prohibit the distribution, or sale, for human food, of any flesh, milk, or eggs produced by such animals.

Evidence that Cows suffered from Hendon Cow Disease.—In reference to the cause of the epidemic, it is a matter of great regret that the forty-one cows which produced No. 1 milk were not all examined by some one acquainted with the Hendon cow disease, during the time that their milk appeared to have been infective.

Mr. W. H. Power, to whom is due the discovery of the connection between such a disease and that of human scarlatina, was instructed by the Local Government Board on Jan. 5, to investigate the outbreak. When Mr. Power arrived at the farm next day, 17 of the 41 cows were already removed, but amongst the 24 that remained he found "some few that appeared to be recovering from affection of the skin and udder, very similar to the malady reported on by Dr. Klein as having occurred amongst certain cows at Hendon" (Mr. Power's *Report*, L. G. B., June 14, 1887).

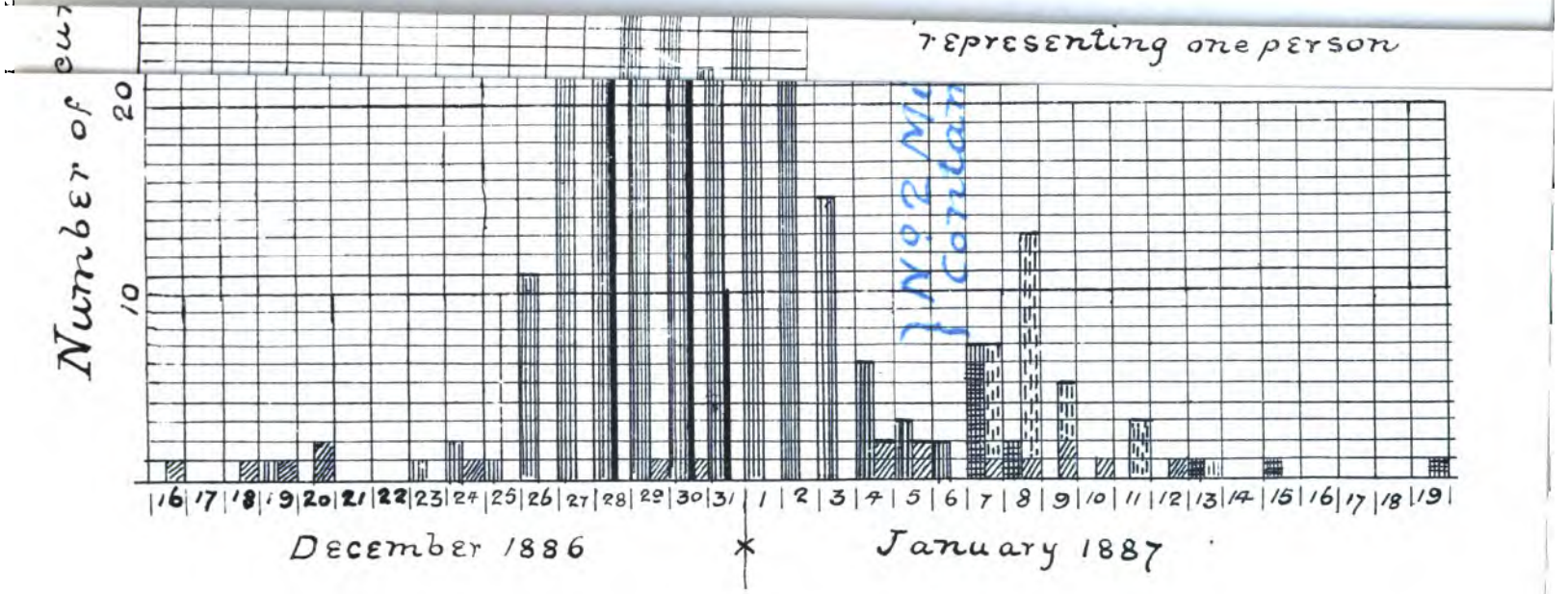
Amongst the seventeen cows that thus escaped Mr. Power's inspection were two important individuals whose milk was added to a supply known as No. 2 milk, amongst the consumers of which twenty-nine attacks subsequently occurred.

Duration of Epidemic.—The epidemic appears to have commenced amongst consumers of No. 1 milk about December 26, when there were 11 cases; the number attacked increased daily to 118 on December 30, and fell to 15 on January 3, when the epidemic ceased, so far as consumers of No. 1 milk were concerned; the distribution of the milk having virtually ceased on December 30.

Table A* gives the numbers that were attacked amongst consumers of No. 1 milk on each walk, and amongst consumers of No. 2 and other milk. Had No. 1 milk been infected by the men delivering the same, or at the dairy, the incidence of attack would have been far greater on certain walks than on others, as the milk supplied on some walks did not enter the dairy.

The total attacks on each service are as follows:—

* This table is omitted.


Representing one person
Number of
20
10
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
December 1886
January 1887

	Writer's Returns. Attacks.	Doctor's Returns.
Amongst consumers of No. 1 milk	577 or 90.7 per cent. of total	473
Amongst consumers of No. 2 milk	29 or 4.5 „ „	25
Amongst consumers of other milk	30 or 4.7 „ „	26
	636	524

Mr. Power, in his report already alluded to, estimates the number of attacks during the week ending January 1, 1887, amongst consumers of No. 1 milk, as 700 times greater than amongst the other residents of the invaded district.

Diagram No. 1 gives the cases attacked, day by day, on each of the milk-supplies named, the dates of attack of which could be fairly ascertained. Diagram No. 2 gives the relation of house-values and quantities of milk supplied to incidence of epidemic. A plan of the district, showing houses invaded on the different milk-services and dates of first case occurring in each house, is also given.

Tables.—The writer was much struck when, investigating the incidence of attack amongst consumers of No. 1 milk, by finding that the wealthier households were much more severely visited than those of their poorer neighbours. But this appears to be of common occurrence in milk-epidemics, due, more probably, to the varying habits of the households, than to the fact that more milk is consumed by the wealthy. For instance, while milk is eagerly drunk raw in well-to-do households, especially by children, amongst the less fortunate it is rarely drunk, except in tea, the heat of which may act in reducing the power of infection. Tables B and C are compiled from the whole of the invaded district, while Table D relates only to Wimbledon. Diagram 2 shows graphically the relations of house-values and amounts of milk supplied to incidence of attack. These tables and diagram relate only to book customers; had it been possible to have included all consumers, the percentage of attacks amongst the poorer households would have been much reduced.

No. 2 Milk.—The writer has alluded to the *two cows* that appear to have infected No. 2 milk, and which had previously formed part of the herd that supplied No. 1 milk.

These cows were purchased on January 5, 1887, by the cowkeeper who supplied the vendor of No. 2 milk, both men

being in a small way of business. The cows were almost fat at the time, and consequently gave little milk; however, the vendor, who up to the morning of the 5th had to augment his supply by foreign milk, was enabled to abandon such foreign milk on the afternoon of that day, as his cowkeeper then supplied him with the amount he required. The writer has no doubt that the cowkeeper got the extra milk he required from the two cows in question.

It appears that the milk of these two cows was first supplied to the consumers of No. 2 milk on the afternoon of January 5, and on the morning and afternoon of January 6, after which the cows were slaughtered.

The following are the cases of scarlatina and throat-illness that occurred amongst the consumers of this milk:—

	6 cases	on 7th January 1887.	
12	„	8th „	
3	„	9th „	
3	„	11th „	
1	„	13th „	in houses already invaded.
1	„	19th „	
3	„	between 7th and 9th.	
Total. 29			

It may be well here to mention, that the two cows just alluded to were not afforded an opportunity to impart infection to other cattle after leaving the herd that supplied No. 1 milk.

The writer has tried to learn of cases occurring amongst consumers of No. 2 milk before January 6, 1887, and after the 11th, but failed to find any except two cases in houses already invaded.

Owing to the panic that prevailed at the time, the writer was unable to make a house-to-house inquiry amongst the consumers of No. 2 milk, for had he done so, he would have interfered with the sale of the milk; but he has no doubt that such an inquiry would have brought to light many more cases amongst such consumers.

The fact that cases occurred as they did amongst consumers of No. 2 milk, does more to fix the primary cause of infection on the herd that supplied No. 1 milk than any secondary fact that has transpired.

Period of Incubation.—An idea of the period of incubation may be gained by the sudden decrease in the numbers attacked subsequent to the stoppage of No. 1 milk, the supply of which was completely stopped after the morning delivery of December 31, 1886; but the consumption of the milk on that morning was much interfered with on account of the

wide spread of the epidemic at that date, and the prevailing belief that the milk had conveyed infection. We may therefore fairly take it that the milk was not consumed to the same extent on the morning of the 31st as it had been on preceeding mornings, or, in other words, the 30th may be taken as the last day the milk was generally consumed. The sudden decrease in the numbers attacked subsequent on the stoppage of this milk occurred on January 1, when there were eighty-six attacks, there being only twenty-five fresh cases the following day.

This sudden decrease corresponds to an incubation-period, in the majority of cases, of less than two days, which appears to be the period maintained throughout the epidemic.

The number of cases of persons who were attacked after exceptionally partaking of No. 1 and No. 2 milks are given in Table E; and it is somewhat remarkable that although four such persons who thus partook of No. 1 milk on the 28th, and three on December 30, 1886, were subsequently attacked, yet, although many persons may have exceptionally partaken of the milk on the 29th, none appear to have succumbed. This would point to No. 1 milk being less infective on the 29th than it had been on the 28th and 30th; if this was so, at some date subsequent to the 29th we may expect to find a decrease in the numbers attacked; this decrease occurred on December 31, when the attacks fell from 118 the previous day to 65, and rose again the following day to 86. Had not a large number of susceptibles already succumbed, no doubt the 86 attacks on the 1st would have been much increased. We have here further evidence of an incubation-period of less than two days in the majority of cases.

The reason why the milk should be less infective on one day than on another may be accounted for by assuming that the particular cow or cows that infected the milk on, say, the 28th, had partly, if not entirely, lost that power on the 29th; but as the disease spread through the herd, a fresh cow, or cows, appear to have acquired the power to infect on the 30th.

In the case of No. 2 milk, we find that the presumedly infective milk consumed on the evening of January 5, 1887, and during the 6th, caused eighteen cases on the 7th and 8th, being 62 per cent. of the cases amongst consumers of this milk the exact dates of attack of which could be fixed. These cases occurred within two days of partaking of the infective milk, again corresponding with an incubation-period of less than two days in the majority of cases.

Ages.—It is a matter to be regretted that the ages of con-

sumers of No. 1 milk were not recorded except in the case of No. 3 walk. Amongst the 405 persons who consumed the milk distributed on this walk, 265 were adults, *i.e.*, persons above 14, of whom 48, or 18 per cent., were attacked, while amongst the remaining 140 children, 86, or 63.6 per cent., were attacked.

Sex.—The sex of persons attacked was only taken in 124 cases; among these 76 were females and 48 males; from which it would appear that attacks amongst females were more prevalent than amongst males.

Infectivity.—Out of the 586 cases recorded as having occurred amongst consumers of No. 1 and No. 2 milks, only ten cases might appear to be due to infection, as they occurred in houses already invaded; the period intervening between the last preceding attack in the houses where such cases occurred, and the attack that might be due to infection, varied from five to fifteen days.

Deaths.—The deaths that occurred amongst the 637 cases attacked numbered only five, one of which was of exceptional interest, being that of a female monkey, on January 9, 1887. This animal had been a large consumer of No. 1 milk, and was attacked about the same time as the other inmates of the house where she resided.

Dr. Klein, who made a *post mortem* of the body, found it affected in exactly the same way as would have been the body of a human being who had died from scarlatina, and from it he extracted the streptococcus of scarlatina, or the Hendon cow-disease. Dr. Klein alludes to the deceased as the "Wimbledon Monkey".

Returns.—The figures given in this paper are taken from two sets of returns, namely, those made by the doctors, to whom forms were supplied on January 8, 1887, and from the returns made by the writer and Mr. Levi White, which were commenced on January 7, 1887, and completed the week following, so far as cases of attack to the 7th were concerned.

In consequence of legal action being threatened by the keeper of No. 1 cows, every care was taken to check the returns.

Hints for future Investigations.—The writer begs to suggest that much valuable information might be obtained respecting epidemics which is now lost, were the Local Government Board to form a small staff of clerks well versed in matters connected with epidemics, who would accompany and assist medical inspectors, when the latter visit the scenes of outbreaks of zymotic disease.

No person, except those who have had to investigate epi-

demics, has any idea of the labour involved and the amount of special knowledge required to collect even the facts necessary for what may be termed a good report on an outbreak; but when it becomes a matter for thorough investigation, so as to get at those facts which would enable Sanitary Authorities to combat these dreadful visitations, the time and labour that would be involved is generally beyond that at the disposal of those engaged in the investigation.

Milk-Trade and Epidemics.—Many persons connected with the milk-trade look with suspicion on those who endeavour to trace the connection between human maladies and milk-supplies. But if such traders were calmly to consider the dreadful consequences that result to their fellow-traders, who have the misfortune to be connected with infected milk, the writer believes that the milk-trade would come forward and demand further investigation, and such legislation as would provide compensation to those who, by no fault of their own, suffer loss on account of what is, so far as at present known, an unpreventable visitation.

Conclusion.—In conclusion, the writer begs to express his thanks to Mr. W. H. Power, at whose suggestions most of the statistics given herein were collected, and who gave the writer every assistance when collecting the same; to Dr. Pocklington, Medical Officer for Wimbledon, to whose prompt action in stopping the supply of No. 1 milk the sudden cessation of the epidemic was no doubt due; to Mr. Levi White, Sanitary Inspector for the Croydon Rural Sanitary Authority, who supplied the information respecting Merton; and to the doctors and consumers of the several milks, who were most willing to give all information in their power.

TABLE B.

Showing Incidence of Epidemic in Houses of various Values supplied with No. 1 Milk.

Rateable Value of Houses.																	
£10 to £12.		£13 to £15.		£16 to £20.		£21 to £25.		£26 to £30		£31 to £35.		£36 to £40.		£41 to £50.		£51 to £60.		£61 and over.	
Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.	Houses Supplied.	Houses Invaded.
33	7	31	12	58	29	52	33	32	21	54	31	25	19	33	24	19	14	15	12
Percentages of Houses supplied invaded.																			
21.2		38.7		50		63.5		65.6		57.4		76		72.7		73.7		80	

TABLE C.

Relation between Amount of No. 1 Milk supplied per House to Incidence of Epidemic.

Amount of Milk supplied per House daily.	Houses Supplied.	Houses Invaded.	Percentage of Houses Supplied Invaded.
¼ pint	15	6	40
½ „	86	34	39.5
¾ „	10	5	50
1 „	76	37	48.7
1½ „	55	32	58
2 „	43	30	69.8
3 „	12	8	66.6
3½ „	19	14	73.7
Above 3½ pints ...	46	36	78.2

TABLE D.

Relation of the Amount of No. 1 Milk supplied per Head to Numbers Attacked.

Milk supplied per Head.	Numbers Supplied.	Numbers Attacked.	Percentage of those Supplied Attacked.
.05 to .1 of a pint ...	113	16	14.1
.1 to .2 „ ...	292	66	22.6
.2 to .3 „ ...	267	110	41.2
.3 to .4 „ ...	168	66	39.3
.4 to .5 „ ...	176	81	46
.5 to .6 „ ...	121	69	57
.6 to .7 „ ...	50	20	40
.7 to .8 „ ...	55	25	45.5
Above .8 „ ...	49	24	49

TABLE E.

Showing Period of Incubation in Cases where Persons exceptionally partook of No. 1 or No. 2 Milk.

	Remarks as to taking Milk.	Date of taking the Milk.	Date of Attack.	Probable Time of Incubation.
Milk No. 1.	Mr. N. returned at tea-time ...	28th Dec.	Evening of 30th Dec.	2 days
	Mr. S. „ in the morning	„	31st Dec.	3 „
	Child M. drank milk at 2 P.M., on returning to Wimbledon	„	Night of 29th Dec.	30 hours
	Miss D. drank half-a-glass of milk	„	2nd Jan.	5 days
	Child T. spent day in Merton, where he drank the milk	30th Dec.	31st Dec.	30 hours
	Child P. returned	„	Night of 2nd Jan.	3 days
	Child W. drank a quantity of milk at a friend's house	„	1st Jan.	2 „
	Mr. H. drank one glass of milk at No. 1 Dairy	31st Dec.	3rd Jan.	3 „
Milk No. 2.	1st Child, W., milk at tea-time	5th Jan.	Midnight of 6th Jan.	30 hours
	2nd „ „ „	„	7th Jan.	2 days
	3rd „ „ „	„	„	2 days
	Mrs. S., milk at tea-time ...	„	Midnight of 6th Jan.	30 hours
	Mr. A. „ „	„	7th Jan.	2 days
	Miss C. „ „	„	„	„

THE PREVENTION OF PHTHISIS.

By J. EDWARD SQUIRE, M.D. Lond., M.R.C.P.,
Physician to the North London Hospital for Consumption.

(*Read: January 9th*, 1889.)

State medicine fulfils its highest object when it successfully attacks the diseases which produce the largest death-rate; and diminishes, where it cannot prevent, the most prevalent maladies, by controlling their determining causes. A glance at the annual report of the Registrar-General shows the tremendous mortality in this country from diseases which affect the respiratory system; and, so far as the peculiarities of our climate account for the prevalence of these ailments, preventive medicine has no scope for action. But where they can be shown to be influenced by causes which are to any extent under control, it is to the interest of the community to direct attention to the removal or amelioration of these conditions.

Amongst affections of the respiratory system two stand out prominently as most frequent causes of death, namely, bronchitis and phthisis. Bronchitis kills most largely at the two extremes of life—in infancy and in old age—and is greatly influenced by climatic conditions. Phthisis, on the other hand, independent of season, claims its victims at that time of life when the individual should be in full vigour, and shows its greatest death-rate between the ages of fifteen and sixty-five, or during the working period of life. The prevalence and intensity of phthisis are influenced by many conditions which result from the aggregation of persons in a crowded population, or from the industries which mark an advancing civilisation. A more intimate knowledge, in later years, of its causation allows us to place it in close relation with the zymotic or infectious diseases, in the diminution of which preventive medicine has already so successfully exerted its influence. Already the more careful attention to sanitary and hygienic conditions of life has had an appreciable effect in diminishing the mortality from phthisis. But such improvement has resulted from measures directed in great part against other diseases—especially those commonly

classed as infectious—or from sanitary regulations adopted on general principles.

The State, which has elaborated regulations to prevent the spread of small-pox or scarlet-fever, has not yet made any systematic attack against a disease which annually kills more than a fourth of all the males who die during the working period of life. It is true that the Sanitary Authorities are not unmindful of the fearful mortality from tubercular diseases, and that the importance of diminishing the *preventable* deaths from this disease has not escaped the attention of the medical advisers of the Government. This is evident from the reports of the Medical Officer of the Local Government Board, especially of late years, where most valuable inquiries into the causes and transmission of tubercle, and of the effects of sanitary improvements on the prevalence of phthisis in certain localities, are recorded. But surely, so wide-spread and fatal a disease requires that regulations should be specially directed against those conditions which can be shown to increase its prevalence or its mortality, and that such measures should be enforced with a completeness commensurate with the national importance of the subject.

I propose in this paper to bring together some of the facts which prove the dependence of phthisis on preventable causes, or, at least, on causes under human control, and to indicate the lines on which preventive measures should be conducted.

Since Koch, in 1881, discovered the bacillus tuberculosis (thus proving the correctness of the views of Chauveau,* Baumgarten,† and others, some of whom had even got so far as to find bacteria and micrococci in tubercular deposits‡), and since the repeated corroboration of his discovery, phthisis must be looked upon—unless we reject the bacillary theory of tubercle altogether—as an infectious disease, in the sense that it is produced by the reception into the body of a specific particle or micro-organism from without, *i.e.*, not originating *de novo* in the body. That the disease does not affect all who are exposed to the infecting cause results from the necessity of the bacillus finding a suitable habitat in the tissues before it can produce spores. With lowered vitality of the tissues the bacillus more easily finds such favourable conditions. This impaired vitality constitutes in the individual a predisposition to tubercle, and may depend upon hereditary

* *Recueil de Méd. Vét.*, 1872.

† *Berliner Klin. Wochenscrift*, 1880.

‡ Zurn, Buhl, Klebs, Schüller, Reinstadler, Toussaint, Aufrecht, Deutschmann.

constitution, or an acquired debility either of the whole system or a particular organ. We have therefore to consider the conditions under which the specific poison or bacillus may be generated and be admitted into the body, as well as the causes which predispose the individual to suffer from its attacks; and to inquire how far both of these may be controlled. Although I do not propose to exclude the non-preventable causes in the following review of these conditions, I shall devote a larger amount of consideration to those which seem to be within the controlling power of hygiene and sanitation.

To commence with the microbe.

The bacillus tuberculosis has three peculiarities which it is most important to bear in mind.

1. It only thrives within a limited range of temperatures, viz., from about 82° to 107° Fahr.

2. It does not form spores in the air.

3. It grows slowly, requiring for its development as many days as the anthrax bacillus requires hours. In artificial cultivation media the bacillus takes from seven to ten days to develop a colony,* and from fourteen to twenty-one days are required to produce a crop of tubercles.

These peculiarities in inoculation experiments† serve to account for the rarity with which healthy persons become infected with phthisis. For, as the bacillus does nor reproduce itself in the air, it must gain entrance into the body, and be retained there for an appreciable time in a suitable habitat, before it can develop. Even if taken into the body it may be expelled before its development is completed; this probably occurs with all of us daily.

The spores, however, appear to resist destruction much more than the bacillus itself.

There are several modes by which the bacillus may gain an entrance into the body.

1. By a cut or scratch on the skin.

This is a true inoculation. Experiments on animals have proved that the introduction of tuberculous matters under the skin or into one of the cavities of the body almost invariably produces tubercle, whilst the introduction of non-tuberculous irritating substances has no such effect.

Such a means of infection is necessarily a rare accident. It has occurred through a cut on the finger, during the performance of an autopsy on a tuberculous patient;‡ from a

* Koch.

† Cohnheim, *Die Tuberkulose vom standpunkte der Infectionslehre*, Leipsig, 1880. ‡ Verneuil, *Le Progrès Médical*, Jan. 26th, 1884.

cut with a spittoon, used by a phthisical patient;* from a bite;† during the Jewish ceremony of circumcision,‡ and in other ways.§ It is seen also in the production of "butchers' tubercles" on the hands, from the handling of tuberculous meat.‖ This generally produces a local tuberculosis only.

2. By means of the genito-urinary mucous membrane.

The possibility of this means of infection seems to be shown by the detection of the tubercle bacilli in vaginal discharges of women,¶ and in the testis and vesiculæ seminales** of males, as well as amongst active spermatozoa in the semen.†† This mode of infection may possibly play some part in cases of transmission of the disease between husband and wife, although the close contact occasioned by occupying the same bed renders the breathing of air expired by the affected person a factor which cannot be overlooked. The occurrence of such infection is well exemplified by two cases, in one of which a tuberculous husband infects successively four wives, all previously healthy,‡‡ and in the other a phthisical woman infects three husbands in succession.§§

3. By the product of conception, and direct hereditary transmission.

The proofs of these modes of infection are not easily obtained. That tubercle may occur in the fœtus has been demonstrated by several observers, both in man‖‖ and amongst animals.¶¶ Cases of tubercle in infants from a few days old are more frequently recorded,*** but, if the child has breathed, still more so if it has been suckled, other sources of infection become possible.

Landouzy and Martin found that animals inoculated with the blood or portions of the internal organs of a fœtus, in which no appearance of tubercle was detected, although

* Tscherning. See *Med. Record*, Aug. 1886.
† Schmidt, *Arbeiten aus der Chirurg. Poliklinik*, Leip., 1888.
‡ Lindmann, *Deutsch. Med. Woch.*, 1883.
§ Lesser, *Deutsch. Med. Woch.*, No. 29, July 19th, 1888.
‖ Lingard, *Evidence before Committee on Pleuropneumonia and Tuberculosis*, 1888, Q. 8025, p. 256.
¶ Cornil and Babès.
** Jani, *Med. Rec.*, 1887, Aug. 15th, p. 341. See also Landouzy and Martin.
†† *Report on Pleuropneumonia and Tuberculosis*, 1888, p. xx.
‡‡ Herman Weber, *Trans. Clin. Soc.*, vol. vii, p. 144.
§§ Zasetzky, *Vratch*, No. 47, 1884, p. 797.
‖‖ Chabrin, Alison, Demme, Scanzoni.
¶¶ Johne, *Wiener Med. Blätter*, No. 15, 1885; Koubasoff, *Comp. Rendu*, 1885, No. 8.
*** Epstein, Thomson, Landouzy and Martin, Angel Money, Huguenin.

the mother died of phthisis, became affected with general tuberculosis.*

4. By the mucous membrane of the alimentary canal.

Numerous experiments have been made which prove the possibility of tubercle being communicated to animals when tuberculous matters are mixed with their food.† As tuberculosis is common in cattle, and affects pigs, rabbits, and fowls, and probably sheep and goats, it becomes an important question as to how far tuberculosis may be communicated to man by means of milk or flesh used as food. Communication by the milk of tuberculous cows has been experimentally effected in animals;‡ and whether this is only possible when the udders are affected, or may occur wherever the seat of the tubercle may be, an additional reason is here found for the inspection of the cows kept for dairy purposes. In the *British Medical Journal* of Jan. 5, 1889, a case is mentioned in which some pigs fed on the milk of tuberculous cows became affected with the disease. Galtier§ concluded that cheese-whey prepared from tuberculous milk might be infective. Cows more readily become tuberculous when kept in close stalls and overcrowded, and over-lactation is a predisposing cause.‖ The milk of tuberculous cows should probably never be allowed to be sold, and tuberculous meat might with advantage be seized and destroyed. The infective power of milk is destroyed by boiling,¶ but cooking meat may not render it innocuous, as the centre of a joint may not get sufficiently heated.** Opinions differ at present as to whether or not human and bovine tuberculosis are identical. Minute differences are described between the bacilli found in man and in cattle,†† and some animals appear not to be equally susceptible to inoculation with human and with bovine tuberculous matters.‡‡ But the weight of evidence at present points to the conclusion that tuberculosis should be included amongst the infectious diseases in the Contagious

* L. Landouzy and H. Martin, *Rev. de Méd.*, 1883, iii.

† Villemin, Chauveau, Tappeiner, Klein and Heneage Gibbes, Gerlach.

‡ Bollinger, Klebs, Foot, Leube, Kommereil and Lochmann, Chauveau, H. Martin.

§ *Comp. Rendu*, t. civ.

‖ Lafosse, *Traité de Pathologie Vét.*, vol. i, p. 432. Also Flemming and Jaccoud.

¶ H. Martin, *Rev. de Méd.*, 1884, p. 151.

** Gerlach; *Report on Pleuropneumonia and Tuberculosis*, 1888, p. xxii; and Lamallerée.

†† Klein, *Rep. of Med. Officer to Local Govt. Board*, 1883-4.

‡‡ Klein, Appendix B., No. 2, *Rep. of Med. Officer to Local Govt. Board*, vol. xv, 1886, p. 149.

Diseases (Animals) Act. The late congress on tuberculosis, in Paris, expressed a strong opinion on the subject in their conclusions, drawn up at the close of the meeting.*

5. By means of the mucous membrane of the respiratory tract, and by the air-cells of the lungs.

This is probably the most frequent mode of infection. Experimental proofs of the efficacy of this mode of infection are numerous,† and it is found that the inhalation of tuberculous particles have more power to produce the disease than their ingestion.‡

The tubercle bacillus has been found in the air of rooms in which phthisical patients are living,§ and the dust from such rooms has been proved to be infective.‖

The above being the modes by which it is possible for the infecting bacillus to gain an entrance into the body, let us see what reasons there are for believing that phthisis may be communicated from person to person.

The contagiousness of phthisis was a matter of popular belief long before experiment proved this point. Many of the older physicians, including Morgagni,¶ believed in it; and Villemin** and Budd†† give reasons for this belief. Evidence of its introduction into previous healthy localities is furnished by the immunity of savage races before their contact with Europeans; and facts are recorded by Webb,‡‡ Flindt,§§ and Alison|||| in support of this view. The latter found that phthisis introduced into previously healthy districts by an affected individual spreads to those in close contact with the invalid, and, having attacked the susceptible, disappears in that locality until reimported.

As the intensity of all infection is necessarily increased by close contact and the crowding together of sick and healthy, the necessity for attention to ventilation and the prevention of overcrowding is apparent, and becomes more so when the conditions which produce a predisposition are considered.

* See *Revue d'Hygiène*, Aug. 20th, 1888, p. 723. For Discussion, see *Gaz. des Hôp.*, 1888, lxi, Nos. 87, 88.

† Giboux, Schottelius, Corning, Tappeiner, Klein.

‡ Tappeiner, Klein.

§ Williams, *Lancet*, March 1883; Ransome, *Proc. Roy. Soc.*, 1882.

‖ Cornet, *Internat. Klinische Rundschau.*

¶ Flemming, *Brit. and For. Med.-Chir. Rev.*, Oct. 1874, p. 461.

** *Etudes sur la Tuberculose*, Paris, 1865.

†† *Lancet*, vol. ii, 1867, p. 452.

‡‡ *The Contagiousness of Phthisis*, 1885.

§§ *Vide* Jaccoud, *Curabilité et Traitement de la Phthisie Pulmonaire*, Lubbock's translation, p. 76.

|||| *Archives de Méd.*, Sept. 1885.

Predisposition.—Next, as to the conditions which favour the development of the bacillus.

In the air of towns and all places where tuberculous persons or animals are congregated there must be large numbers of tubercle bacilli. We must, therefore, continually take in these microbes with each inspiration, and yet only a certain proportion of individuals become affected with phthisis. In health it is probable that the expiratory act, aided by the ciliary action of the bronchial mucous membrane, may expel the bacilli before they have been able to develop; or that, having escaped expulsion, they do not find the tissues in a condition to afford a suitable *nidus*. But should the expiratory effort be deficient, or the vitality of the tissues be impaired, the microbes may not only effect an entrance into the lungs, but easily find there favourable conditions for their development. Both these effects may result from disease of the respiratory organs, or from constitutional enfeeblement; and we may therefore affirm generally that a predisposition to phthisis is produced by diseases of the respiratory apparatus, and by any causes which depress the health—such as insufficiency of food, air, and exercise; fatigue, mental depression, dissipation, and exhausting illness.

We will now examine the more important predisposing causes in detail.

1. *Hereditary Predisposition.*—Apart from the possible direct transmission of tubercle from parent to offspring, mentioned previously (p. 51), the children of unhealthy parents, such as those affected with phthisis, are often of weak constitution, and thus inherit a general predisposition to tubercle. Increased care is then requisite, especially during the time of growth and development, not only to remove or diminish this susceptibility by physical training, but to keep them from surroundings and occupations which in themselves produce or increase the predisposition. To prevent the marriage of phthisical persons may be theoretically desirable, but is far removed from the range of practical hygiene.

2. *Influence of the Air and Sun.*—Sunlight and fresh air are essential to healthy life, and to ensure an adequate supply of both is the basis of all hygiene. As it is in dwellings and workshops that deficiences of both are most commonly met with, the influence of this cause may be remembered in discussing habitations and occupations.

3. *Age and Sex.*—Pulmonary phthisis is essentially a disease of adolescence and adult life. Though tubercle attacks children from infancy, it is then more generalised,

and affects other parts—such as the intestinal tract, the glands, and the membranes of the brain—with greater frequency than it affects the lungs. Even if tubercular meningitis may be a result of direct inheritance, the affection of the mesenteric glands suggests infection through the alimentary canal. In adults the lungs are most commonly the starting-point of the infection, which may spread later to other organs.

The two sexes seem to be affected by pulmonary phthisis in almost equal proportions, but the disease appears to commence at an earlier age and to run a more rapid course in females. Exhausting discharges—such as menorrhagia, debility from rapid child-bearing, and over-lactation, produce in women a predisposition which must not be overlooked.

4. *Occupation.*—The influence of occupation as a predisposing cause of phthisis has long been recognised, and is of the utmost importance, not only because it operates so widely, but because it is one of the causes which it may be found possible to control and diminish. The large incidence of phthisis upon those who follow dusty employments has attracted much attention from observers. Dr. Greenhow* calculated that forty-five thousand deaths occurred annually from this cause in England and Wales, and he believed that the whole of this mortality was preventable by the introduction of better methods of ventilation and working. Dr. Pollock† also gives good evidence of the predisposing influence of certain indoor and dusty occupations. In these cases the susceptibility to phthisis evidently arises from the inhalation of fine, irritating particles into the lungs, and the consequent impairment of these organs, rendering them more susceptible to the invasion of the bacillus, which readily finds a suitable nidus in the damaged tissue. Amongst dusty occupations, stone-masons, coal-miners, knife-grinders and needle-polishers, chaff-cutters, and those employed in hackling flax, carding cotton, grinding steel, porcelain and pearl for buttons, mattress-making and cleaning, etc., afford instances of the effect of dust in producing a large mortality amongst those who follow these callings. Amongst the potters in Staffordshire, phthisis caused 18.1 per cent. of all deaths for males, and 11.5 per cent. for females‡; and the effect of the occupation is well shown by comparing the proportion of cases of phthisis amongst the potters who were

* E. Headlam Greenhow, M.D., *On the Prevalence of Certain Diseases in different Districts in England and Wales.* Papers relating to the Sanitary State of England to the General Board of Health, 1858.

† *The Elements of Prognosis in Consumption*, 1865.

‡ *Report on the Staffordshire Potteries to the Med. Dept. of the Local Govt. Board*, 1872, Appendix B., p. 44.

admitted to the North Staffordshire Infirmary with that amongst other classes.

The potters showed 20.9 per cent. for males and 16.96 for females suffering from phthisis, whilst the males who were not potters gave a proportion of 13 per cent., and the females 11 per cent.* In cotton factories, few men who enter certain rooms ever live to attain thirty-eight years of age.† Dr. Pollock‡ suggests that a veil should be worn over the nostrils and mouth, and that the men should grow beards. But he adds: "A perfect ventilation and extreme cleanliness are, however, the best modes of prevention. The metallic dust in mines, the floating particles of flax, cotton, and straw, are all possible to remove, rather let us say impossible to continue, in the presence of a good system of ventilation." This strikes the key-note of all regulations for the prevention of phthisis. In certain well-ventilated mines the mortality is one-third less than in others less well-managed, and the simple use of the fan in workshops materially lessened the quantity of disease among the grinders of Sheffield.§

Apart from the irritating effects of dust, the influence of occupation is found in the large amount of phthisis amongst those who follow indoor and sedentary occupations of whatever kind. Here we have to take into account insufficient exercise and the want of fresh air, not only from the large amount of time spent indoors, but from the frequent overcrowding of work-rooms.

Amongst tailors, Dr. Edward Smith‖ found that consumption and other forms of chest-disease constitute two-thirds of all the causes of death; but this computation would appear to be too high, for in the ten years from 1871 to 1880 the mortality from phthisis and diseases of respiratory and of the circulating system amongst tailors does not constitute two-thirds of their total mortality.¶ The proportion is more nearly one-third. Dr. Ord** noticed the prevalence of phthisis amongst dressmakers and milliners, and attributed it to the long hours, want of exercise, and deficient ventilation of work- and bed-rooms. Although the Factory Act allows of the inspection of work-rooms where numerous persons are

* Dr. Arlidge, *Social Science Congress*, Leeds, 1871.
† Pollock, *The Elements of Prognosis in Consumption*, 1865.
‡ *Op. cit.*, p. 370. § Pollock, *loc. cit.*
‖ *Report of Med. Officer to Local Govt. Board*, vol. vi, 1863, p. 429.
¶ *Supplement to the Forty-Fifth Annual Report of the Registrar-General*, 1871-80, p. xxxix.
** *Report of Med. Officer to Local Govt. Board*, vol. vi, 1863, p. 362, Appendix 10.

employed,* overcrowding is probably still rather the rule than the exception. Each work-room should be licensed to hold a certain number of persons for so many hours a day, the number being determined in each case not only by the cubical contents of the room, but by taking into consideration the means of ventilation; and some penalty should be enforced if the number of workers is exceeded. But perhaps the most serious class of cases, and certainly the most difficult to bring under control, is that large body of persons who take the work to their own homes. Amongst the home-workers it is not uncommon to find a single room serving as living-room for a whole family, and work-room for the older members. A typical example from my own observation is the following:—In a room, half of which seems to be taken up by a bedstead, on which lies a woman dying of consumption, the husband is at work before a fire (although it is summer) pressing a coat, the steam from which, as he presses the hot iron over the damp cloth, renders the close air humid; beside him his son sits stitching at some other garment, and near the bed is the eldest daughter with her sewing machine, probably waistcoat-making, whilst two or three younger children play about on the floor; the single window is shut and cannot be opened, either because the frame is too rotten, or because from long disuse it has stuck too tight to move. Where could anyone imagine a better field for the operations of the tubercle bacillus?

Mr. Lakeman, Inspector under the Factory Act for the northern district of the metropolis, in his evidence before the Select Committee of the House of Lords, now sitting to inquire into the sweating system, is reported to have suggested that all places in which work was done should be registered; even if a father, mother, and two or three daughters were working in their own cottage in the country for someone else, he would have the cottage registered. Such a plan, however desirable for some reasons, would tend to strike at the privacy of home-life, and could not be tolerated. But the evil might be diminished—in the same way that public wash-houses have removed the necessity of filling a room with freshly washed linen hung up to dry—by the establishment by local authorities of public work-rooms, where for a small sum a man might take his work and find conveniences and appliances for his occupation, besides companionship. A woman's room would probably attract a large number of poor seamstresses and waistcoat-makers,

* See Factory Acts, 1864-67; Work-places Regulation Act of 1867; and Section 19 of Sanitary Act of 1867.

especially if a *crêche* in the neighbourhood relieved them of the care of the younger children whilst the others were at school. Then there might be some pleasure in the family reunion in a fresh, well-ventilated room at home after the day's work was over, and the head of the family would have less excuse for spending the evening at the public-house.

The influence of dust is added to the want of ventilation in the predisposition to phthisis which is so marked amongst printers. Dr. Edward Smith* found that amongst the printers of London, phthisis, in proportion to other diseases, is twice as prevalent as even among the general male population of London, and furnishes 46 per cent. of all the causes of death in the men who follow this employment. He gives some suggestions for remedying the unhealthiness of the printer's occupation. The want of ventilation is most marked where unsuitable buildings have been adapted to suit the trade, and less where the premises have been specially built for the business. In the compositors' rooms, where the window is the chief provision for the entrance of air, a difficulty arises from the type-frames being placed immediately under these, so as to be in a good light. The men then find the draught too great when the window is open, and therefore keep it closed. Such rooms should be provided with some ventilating inlet which diffuses the incoming current of air (*e.g.*, Harding's), and so prevent draughts.

Amongst unhealthy occupations we may also include that of bakers, who suffer from the effects of inhaling flour-dust, of bad hours, and of exposure to extremes of temperature; and carpenters who inhale wood-dust. Actors, also, and persons employed behind the scenes in theatres, suffer from dust, bad hours, and draughts. Inn-keepers were found by Alison† to present a high proportion of phthisis cases, which he attributed partly to alcoholic excess; and billiard-markers suffer from long hours in a bad atmosphere in addition.

With regard to indoor occupations generally, it is found that "in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion, other things being equal, their respective death-rates by lung-disease (phthisis) is increased."‡

Preventive measures against phthisis should commence with an efficient inspection of factories, workshops, and mines; overcrowding should be prevented, and ventilation enforced. Power is now given to enforce ventilation in

* *Report of Med. Officer to the Local Govt. Board*, vol. vi, 1863.
† *Op. cit.*
‡ *Third Report of Med. Officer to the Privy Council*, 1860, p. 30.

work-places,* but the importance of the subject to the health of the community requires that such power should be far more used than it is at present. If anything were wanting to emphasize the influence of indoor occupations on the amount of consumption, it might be found by contrasting the comparative immunity from this disease enjoyed by nomadic races or by the ranche men of Australia. Even log-rolling in Canada has been effectual in removing a tendency to pulmonary phthisis.

5. *Locality and Habitation.*—Under this heading we may include the influence of localities with regard to climate and temperature, altitude, nature of the soil, and density of the population; and finally, the effect of insanitary conditions in dwelling-houses.

(*a*) Locality and Climate.—Popular opinion is still too apt to consider phthisis as depending upon the nature of the climate, and therefore to look upon a high death-rate from consumption as an inevitable necessity in this country. But tubercular phthisis is found in almost every variety of climate, from the heat of India to the cold of Canada. The variableness of our climate exerts some influence by producing frequent catarrh and inflammation of the respiratory organs, and thus predisposing them to receive and retain the infective bacilli, and in this way cannot be disregarded. But I believe the influence of climate is infinitesimal when compared with the effect of the density of population in this country.

(*b*) Altitude.—There seems to be no doubt that in elevated regions—especially if over 5,000 feet above the sea-level—the tendency to phthisis is diminished. This is probably due not only to the purity of the mountain air, but also to the diminution of atmospheric pressure, which allows greater chest-expansion. But, unless hygienic conditions are attended to, the good effects of altitude may be counterbalanced. In the factories of the Jura mountains, with a large working population, at an altitude of 3,500 ft., tuberculosis is common.†

(*c*) Nature of the Soil.—It is hardly necessary in this Society to remind you of Dr. Buchanan's observations on the influence of moisture of the soil upon the prevalence of phthisis. He noticed that the drying of the ground by the drainage works of certain towns was followed by a marked decrease of phthisis. The improvement noticed in fifteen towns, was from 49 per cent. in Salisbury, and 47 per cent. in Ely, to 11 per cent. at Merthyr.‡ Following up these observations, a further in-

* *Fourth Report of Med. Officer to the Privy Council*, 1861, p. 29.
† Jacobi, *Archiv. de Pediatr.*, vol. v, No. 10.
‡ *Report of Med. Officer to the Privy Council*, vol. ix, 1866.

quiry was instituted into the dependence of phthisis upon the dryness of the soil, and he was able to show that, in a number of districts, the prevalence of phthisis had a marked relation to the proportion of inhabitants who lived on pervious or on retentive soil. In the group of districts where phthisis was least prevalent, 909 per thousand of the inhabitants lived on pervious soil, and only 91 per 1,000 on retentive soil, and in the most phthisical districts the proportion was 642 on pervious, and 358 on retentive soils in every thousand inhabitants.*

A similar dependence on the dampness of the soil was noticed by Bowditch† of Boston, U.S., in 1862, and these observations were afterwards confirmed by the Registrar-General for Scotland.‡

Here again we have a predisposing cause of consumption which can be remedied by drainage, and should not be neglected.

(*d*) Density of Population.—The prevalence of phthisis wherever large numbers of persons are congregated together, as in towns, is partly due to the increased opportunities for direct infection, as well as to the predisposing effect of the unhygienic accompaniments of town-life. Dr. Farr§ shows that the increase in deaths from consumption in cities over those in country districts is as much as 39 per cent., and also that for every person who dies of consumption in the counties, 1.24 die in the cities. He says: "The tendency to consumption was increased 24 per cent. to typhus 55 per cent. in the town districts; but as the absolute mortality from consumption is three times as great as from typhus in towns, and nearly four times (3.73) as great in the country, the excess of deaths from consumption caused by the insalubrity of towns is greater than the excess of deaths by typhus."‖

The effect of town-life is also shown by the fact that, whereas the death-rate for phthisis for London is 1,858 for every million persons living,¶ that for the extra-metropolitan portions of the counties of Middlesex, Surrey, and Kent is only 1,393 per million persons living—or only three-quarters of the London death-rate.

(*e*) Dwelling-houses.—The injurious effects of inattention

* *Report of Med. Officer to the Privy Council*, vol. x, 1867.

† *Consumption in New England and elsewhere; or, Soil-Moisture one of its Chief Causes*, Boston, 1868.

‡ *Seventh Annual Report of Registrar-General for Scotland.*

§ *Vital Statistics*, 1885, p. 167.

‖ *Ibid.*, p. 172.

¶ *Registrar-General's Report*, vol. xvii, 1887.

to hygienic details in dwelling-houses may depend upon faulty construction or on overcrowding. Dampness may be prevented by a concrete foundation, and by the insertion of a damp-proof course in the brick-work, just above the level of the ground. But what can be said for the underground rooms in faultily constructed houses in which whole families live in our towns? Healthiness, under such circumstances, is too much to expect. Although it may be too late to remedy essential structural defects in existing houses, precautions to exclude damp ought to be insisted upon in all newly constructed houses. So, too, efficient means of ventilation—whether by windows or otherwise—should be insisted upon by inspectors of new buildings before they are certified as fit for habitation. We have, fortunately, now no window-tax, which unintentionally placed a premium on light and fresh air in dwellings; and the minimum area of windows to each room should be regulated by law: and some such regulations as are suggested in the Model Bye-laws of the Local Government Board* should be in force for the whole country. So, too, the minimum height of rooms should be regulated according to their floor-area.

But no provisions of this kind will ensure efficient ventilation where houses are crowded together without sufficient open space round them. Dr. Ransome,† in a paper read before this Society last session, has collected some valuable evidence, showing the marked prevalence and spread of phthisis where houses are densely crowded together. In London, although an open space is required in rear of each house, this may be built over to the height of the ceiling of the ground-floor; and even this small provision for thorough ventilation only applies to houses built upon land not occupied before 1882. Where houses are built back-to-back, through-ventilation is impossible, and the progressive phthisis death-rate in direct ratio with an increased percentage of houses unfurnished with means of through-ventilation, is very suggestive.‡ If back-to-back houses must be permitted at all, they should be built in blocks of four houses, with an open space between each block and windows on all four sides.

The regulation of the width of streets is also of importance. No court or street, under a certain breadth, should be allowed to be blocked at either end: there should always be an open-

* Knight's *Annotated Model Bye-laws of the Local Govt. Board*, 1885. IV. New Streets and Buildings, Bye-laws 57, 58, p. 112.

† *Trans. Epidemiological Soc.*, N. S., vol. v, 1886-7, p. 124.

‡ *Report on Back-to-back Houses, Local Govt. Board*, 1888, p. 41.

ing at each end of a narrow street or court, one, at least, being of the full width of the court, and open from the ground upwards; the height of the houses should be regulated by the width of the street or court; and the length of narrow streets should be limited. Such regulations are contained in the Local Government Board's Model Bye-laws; and if section 157 of the Public Health Act of 1875 were made compulsory, instead of permissive, they could easily be enforced throughout the country.

But, even if we get houses properly built and healthily situated, we cannot expect diminution of phthisis unless the number of inhabitants is regulated to the size of the dwelling. Overcrowding in dwelling-houses is as potent a cause in breeding consumption as the insanitary condition of the houses. Nothing could demonstrate this more forcibly than the experience of the army. In 1839 the average mortality throughout the army from diseases of the lungs was about eight per thousand annually, of which four-fifths arose from consumption, whereas the highest estimates in civil life were only half as much. Amongst the troops, the highest death-rate from these causes was in the Foot Guards, where it was 13.8 per thousand. That the Guards were not more susceptible to diseases of the lungs than the other troops, was shown by the fact that when they were serving in Canada they were less affected by these diseases than the infantry of the line who were in that country, whilst the infantry of the line who took over the barracks in London which were vacated by the Guards showed a greater amount of sickness than the usual amount for the same period amongst the Guards under similar conditions. This at once points to some local causes, which were thus summarized*:—Defective barrack accommodation; the great amount of night duty; the deteriorating influence of residence in a large town; the greater facilities for, and temptation to, dissipation.

It is a curious commentary on the slowness with which matters relating to health receive official attention, to find the report of a commission to inquire into the causes of this excessive mortality† dated nearly twenty years later than the report from which the above facts are taken. But when the barrack accommodation was improved, although the other conditions mentioned above remained, the mortality from

* *Statistical Reports on the Sickness, Mortality, and Invaliding among the Troops in the United Kingdom, the Mediterranean, and British America,* 1839.

† *Report of the Commission to Inquire into the Excessive Mortality in the Army,* 1858.

chest and tubercular diseases amongst the troops at home-stations fell from 10.1 to 4.2 per thousand.* Attention to ventilation and overcrowding in prisons also has considerably diminished the death-rate from phthisis in those institutions.

Overcrowding is still a marked characteristic of the habitations of the poor,† and its evil effects are increased by the dread of allowing air to enter their rooms direct from outside. Thus ventilation is unknown and dirt is rampant. Some improvement could be effected by enforcing throughout the country the Bye-laws as to houses let in lodgings‡ (Public Health Act, 1875); by placing tenement-houses under the regulations drawn up for common lodging-houses§; or by some such measures as are in force in Glasgow for the "ticketed-houses" in that city. But only personal influence can prevent the overcrowding which is to be found in the houses of the better classes, where servants are made to sleep in rooms little better than cupboards, or in a cellar under the front door-steps.

6. *Influence of Certain Diseases—local and general.*—Several maladies produce a predisposition to tuberculosis by their local impairment of vitality of the lungs—such as bronchitis, pneumonia, pleurisy, and repeated catarrhs; others by their general lowering of the resisting power of the tissues —such as typhoid-fever and diabetes; and insanity may be placed amongst these predisposing maladies. Measles and whooping-cough possibly act both generally and locally. The present severe epidemic of measles in London will, in all probability, be the starting-point of numerous cases of tuberculosis, which might have been prevented if means had been taken to stop the spread of the epidemic by the timely closing of schools. Deformities of the chest, such as occur in rickets, act locally by diminishing expiratory power. Alcoholism seems to act as a predisposing cause by its general debilitating effect; and in considering the large incidence of phthisis on tailors and printers, the tendency to heavy drinking in these trades must not be overlooked. Injury to the lung may also be the starting-point of phthisis. Thus, successful sanitary measures directed against other diseases may affect the amount of phthisis; and philanthropists can

* *Our Homes, and How to make them Healthy*, 1883, p. 502. See also Lawson, "Phthisis in the Army", *Journ. of Statistical Society*, Jan. 1887.

† Vide *Report of Royal Commission on the Housing of the Working Classes*, vol. i, p. 7.

‡ Public Health Act, 1875, sect. 90.

§ *Idem*, sect. 80.

give material assistance in diminishing the prevalence of this disease by their fight against dirt, drink, and dissipation.

It appears, then, that many of the conditions on which phthisis depends come well within the reach of preventive medicine. The fundamental principles which must form the basis of any successful attempts to diminish the prevalence of this disease are—(1) to provide a sufficiency of fresh air in and around dwellings and work-places, and (2) to endeavour to improve the resisting power of the individual by hygienic and physical training during the period of growth and development, and, in later life, by exercise and recreation to relieve the strain of continuous application in the struggle for existence. Gymnastics and games form an important part of the details of school-life, as well as mental training; and work is better done at all times if healthy relaxation alternates with labour. Anything which provides for healthy recreation for the working-classes after their day's work is over must tend to improve their physical condition, and consequently their resisting power against disease.

We owe it to succeeding generations, as well as to those of our own day, to allow no time to be lost in commencing a systematic attack against a disease which annually destroys so many useful lives, and which is handed down in so many families as a fatal inheritance.

If any apology is needed for such a paper as this, it may be found in the words of Sir John Simon—that the mortality of phthisis ought to be very jealously criticised, for "the tendency to tubercular disease is one which transmits itself from parent to child; and thus, if in any one generation the disease be artificially engendered or increased, that misfortune does not confine its consequences to the generation which first suffers them. Whatever tends to increase tubercular disease among the adult members of a population must be regarded as assuredly tending to produce a progressive degeneration of race."*

* *Introductory Report of Med. Officer to the General Board of Health.* Papers relating to the Sanitary State of the People of England, 1858, p. xxii.

BIBLIOGRAPHY.

Bacteriology.

AUFRECHT, E.... ... Centralbl. f. d. med. Wissensch., Bd. xx, No. 17, 1882.
„ ... ... Deutsche med. Wochenschr., Bd. viii, No. 30-31, 1882.
BAUMGARTEN ... ... Berliner klin. Wochenschrift, Bd. xviii, No. 49, p. 697, and No. 50, p. 713, 1880.
„ ... ... Centralbl. f. d. med. Wissensch., Bd. xix, 1881.
„ ... ... *Ibid.*, Bd. xx, 1882; Bd. xxi, 1883; and Bd. xxii, 1884.
BUHL ... ... Lungenentzündung, Tuberculose u. Schwindsucht. München., 2 Aufl., 1873.
CANTANI ... ... London Med. Rec., Nov. 16, 1885.
CHAUVEAU ... ... Recueil de Méd. Vétér., No. 3, 1869.
„ ... ... *Ibid.*, 1872.
„ ... ... Bull. de l'Acad. de Méd., Paris, t. xxxiii, 1868.
COHNHEIM ... ... Uebertragbarkeit der Tuberculose, Berlin, 1877.
DEUTSCHMANN ... Centralbl. f. d. med. Wissench., No. 18, 1881.
KLEBS ... ... Tageblatt d. Versammlung deutsch. Naturforscher u. Aerzte in München, 1877.
„ ... ... Archiv. f. Experim. path. n. pharmakol., Bd. i, 1873.
„ ... ... *Ibid.* Bd. xvii, 1883.
„ ... ... Archiv. f. pathol. Anat., Bd. xliv, 1868.
KOCH ... ... Berl. klin. Wochenschr., Bd. xx, No. 15, 1882.
„ ... ... Die Ætiologie der Tuberculose, Berlin, 1882.
„ ... ... Mittheil. aus d. kaiserl. Gesundheitsamte, Bd. ii, 1884.
REINSTADLER ... ... Archiv. f. exper. Pathol., Bd. xi.
SCHÜLLER ... ... Archiv. f. exper. Pathol., Bd. xi.
SPINA ... ... Studien über Tuberculose, Wien., 1883.
TOUSSAINT ... ... Compt. rend. Acad. des Sciences, 1880.
„ ... ... *Ibid.*, 1881.
ZIEGLER ... ... Lehrbuch der Allg. u. spec. Pathol. Anat., 1881.
ZURN ... ... Zoopathol. u. Zoophysiol. Untersuchungen, 1872.

Inoculation Experiments.

BAUMGARTEN ... ... Centralbl. f. d. med. Wissensch., Bd. xxi, No. 42, 1883.
COLIN ... ... Bull. de l'Acad. de Méd., t. xxxii.
FELTZ ... ... Gaz. Méd. de Strasbourg, Oct. 25, 1867.
FOX, WILSON ... ... Brit. Med. Journ., vol. i, pp. 499, 525, 551, 1868.
KLEIN ... ... Rep. of Med. Off. to Local Govt. Board, vol. xiii (Supplement), 1883.
LEBERT AND WYSS ... Virchow's Archiv., Bd. xli, 1867.
MARTIN, H. ... ... Rev. de Méd., t. ii, 1882.
„ ... ... *Ibid.*, 1884.
„ ... ... Recherches Anatom-path. et exp. sur la tuberculose, 1879.
„ ... ... Archives de physiologie, 2 s., viii, 1881.
ROUSTAN ... ... Recherches sur l'Inoculabilité de la Phthisie, Paris, 1867.
SANDERSON, J. B. ... Tenth Report of the Med. Off. to the Privy Council, App., No. 6, 1867.

SCHILL AND FISCHER... Mittheilungen aus dem k. Gesundheitsamte, 1884.
SIMON, J. ... ... Trans. Pathol. Soc., vol. xviii, p. 290, 1867.
STERNBERG, G. ... Amer. Journ. Med. Sciences, Jan. 1885.
VILLIMIN ... ... Études sur le tuberculose, Paris, 1868.
VOGEL ... ... Deutsches Archiv. f. klin. Med., July 1886.
WALDENBURG ... ... All. Med. Centralzeitung, Dec. 18, 1867.
WILLIAMS, DAWSON ... Trans. Pathol. Soc., vol. xxxv, 1884.

Accidental Inoculation.

EVE, F. S. ... ... Lancet, vol. i, p. 170, 1888.
LAENNEC ... ... Traité d'Auscultation Médiate, p. 221, 1837.
LESSER ... ... Deutsche Med. Wochenschrift, No. 29, July 19, 1888.
LINDMANN ... ... Deutsche Med. Wochenschrift, No. 30, 1883.
SCHMIDT ... ... Ein Fall v. localer Impftuberculose, Leipsig, 1887.
TSCHERNING ... ... Centralbl. f. klin. med., June 20, 1885.
VERNEUIL ... ... Le progrès Méd., Jan. 26, 1884.

Infection through the Genito-urinary Mucous Membrane.

CORNIL ET BABÈS ... Bull. de l'Acad. de méd., 1883.
CARRERA Y MIRÓ ... Gac. Med. Catal., xi, p. 385, Barcelona, 1888.
DERVILLE, LÉON ... De l'infection tuberculeuse par la voie génitale chez la femme, Paris, 1887.
JACQUOT ... ... Infection tuberculeuse par la voie génitale, Paris, 1888.
JANI ... ... Virchow's Archiv., March 1886.
LANDOUZY ET MARTIN Rev. de Méd., t. iii, 1883.
WEBER, HERMANN ... Trans. Clin. Soc., vol. vii, p. 144, 1874.
ZASETZKY ... ... Vratsch, No. 47, p. 797, 1884 (*vide* Med. Rec., p. 100, 1885).

Tubercle in the Fœtus and in Infants.

Fœtus—Human.

BOSSELUT ... ... Méningite tuberculose de jeunes enfans, 1888.
CHABRIN ... ... Lyons Médicale, t. xiii, p. 295, July 1873.
DEMME ... ... Ber. d. Jenner'schen kinderspit. in Bern. s. 24, 1875.
„ ... ... 21 Jahrsb. des Berner Kinderspital, 1884.
LANDOUZY ET MARTIN Rev. de Méd., t. iii, 1883.
LANDOUZY ET QUEYRAT Gaz. hebd. de Méd., 2 s., xxiii, p. 255, 1886.
MERKEL ... ... Central bl. f. öff. Gesund., Bd. iv, p. 104, 1885.
SCANZONI ... ... Lehrb. d. Geburtshülfe, 1 s., p. 358, 1852.
QUEYRAT, L. ... ... Contribution a l'étude de la tuberculose du premier âge, Paris, 1886.

Fœtus—Animals.

JOHNE ... ... Fortschritte der Med. No. 7, p. 198, 1885.
KOUBASOFF ... ... Compt. Rend., No. 8, 1885.
SEMMER ... ... Virchow's Archiv., Bd. lxxxii, p. 547, 1880.
WALLEY, T. ... ... Edin. Med. Journ., vol. xxxiii, part 2, p. 991, 1888.

Infants.

EPSTEIN ... ... Prager Vierteljarhschrift, Bd. 142, p. 103, 1879.
HUGUENIN, P.... ... Gaz. des Hôp., lxi, p. 785, July 26, 1888.
LANDOUZY ... ... Rev. de Méd., May 1887.
LOREY, C. ... ... Lyons Méd., t. xiv, p. 299, 1873.
MONEY, ANGEL ... Brit. Med. Journ., June 20, 1885.

Infection through the Alimentary Canal.

CHAUVEAU ... ... Rec. de Méd. Vétér., No. 3, p. 202, 1869.
„ ... ... Lyons Méd., t. xiii, p. 577; t. xiv, p. 203, 1873.

Colin	... ...	Bull. de l'Acad. de Méd., No. 21, 1873.
Gerlach	... ...	Virchow's Archiv., Bd. li, Heft 2, p. 290, 1870.
Klein	... ...	Rep. of Med. Off. to Local Govt. Board, 1884 and 1885.
Lamellerée	... ...	Gaz. Méd., Aug. 15, 1886.
Tappeiner	... ...	Deutsch. Archiv. f. klin. med., Bd. xxix, 1881.
Villemin	... ...	Études sur la tuberculose, Paris, 1868.

By Milk.

Bang	... ...	Int. Med. Congress, Copenhagen, 1884.
"	... ...	Deutsch. Zeitschrift f. Thiermed., Bd. xi, p. 45, 1885.
"	... ...	Tidsk. f. Landækonomi, 1886.
Böllinger	... ...	Archiv. f. exp. Path. u. Pharm., Bd. i, 1873.
"	... ...	Versammlung deutsch. Naturforscher u. Aerzte. Baden, 1879.
Galtier	... ...	Compt. Rend., t. civ.
Gerlach	... ...	Jahresb. über d. k. Thierarzneischule in Hannover, 1869.
"	... ...	Virchow's Archiv., Bd. li, p. 299, 1870.
Klebs	... ...	Archiv. f. exp. Path. u. Pharm., Bd. i, 1873.
Martin, H.	... ...	Rev. de Méd., p. 151, 1884.
Nagy, J.	... ...	Gyogyaszat, Budapest, Bd. xxviii, p. 115, 1888.
Parkes, L.	... ...	Brit. Med. Journ., vol. i, p. 847, 1888.
Schreiber	... ...	Zur Lehre von der artificiellen Tuberculose, Kœnigsberg, 1875.
Schmitt, M. J.	...	De la tuberculose expérimentale, Thèse d'agrég., Paris, 1883.
Stein	... ...	Experimentalle Beitrage zur Infectiosität perlsuchtiger Kühe, Berlin, 1885.
Steigenberger	...	Gyogyaszat, Budapest, Bd. xxviii, p. 77, 1888.

By Meat.

Gerlach	... ...	Ist das Fleisch von tuberkelkranken Thieren als Nahrungsmittel für Menschen zu vervenden, Berlin, 1874.
Lamellerée	... ...	Gaz. Méd., Aug. 15, 1886.
Nocard	... ...	Rec. de Méd. Vét., s. 7, t. v, p. 569, 1888.
"	... ...	Discussion at Congress on Tuberculosis, Paris (*vide* Gaz. des Hôp., lxi, p. 806, 1888).
Vittu	... ...	Lyons Méd., t. xiii, p. 522, 1873.

Relation between Bovine and Human Tuberculosis.

Creighton	... ...	Bovine Tuberculosis in Man, 1881.
"	... ...	Lancet, vol. i, p. 943, 1880.
Crisp	... ...	Trans. Pathol. Soc., vol. xxiv, p. 346, 1873.
Flemming	... ...	The Influence of Heredity and Contagion on the Propagation of Tuberculosis, 1883.
"	... ...	Brit. and For. Med. Chir. Rev., Oct. 1874.
Klein	... ...	Practitioner, vol. xxvii, p. 81, 1881. Rep. of Med. Off. to Local Govt. Board, 1883-86.
Nuvoletti, G.	...	Dell'identita della tisi perlacea dei bovini colla tuberculosa umana, Verona and Padua, 1887.
Schüppel	... ...	Virchow's Archiv., Bd. lvi, p. 38, 1872.
Young, A. G.	...	Rep. to the Board of Health, Maine, U.S., 1887.
Walley, T.	... ...	Edin. Med. Journ., vol. xxxiii, Part ii, pp. 904 and 1078, 1888.
Woodhead, Sims	...	Reserches on Tuberculosis, *vide* Public Health, No. 5, p. 132, Sept. 1888.

Report ... ... Of the Departmental Committee appointed to enquire into Pleuropneumonia and Tuberculosis in the United Kingdom, 1888.
„ ... ... On Tuberculosis in Cattle, Colony of Victoria, 1884-5.
„ ... ... Of Paris Congress on Tuberculosis, Gaz. des Hôp., lxi, Nos. 87 and 88, 1888.

Infection by Inhalation.

GIBOUX ... ... Comp. Rend. Acad. des Sciences, May 22, 1882.
KLEIN ... ... Suppl. to Rep. of Med. Off. to Local Govt. Board, vol. xiv, 1884.
SCHILL AND FISCHER... Mittheilungen aus dem k. Gesundheitsamte, 1884.
SCHOTTELIUS ... ... Virchow's Archiv., Bd. lxxii, 1878.
„ ... ... Centralbl. f. med. Wissensch., 1878.
SIRENA AND PERNICE... Gaz. degli Ospitale, March 29, 1885.
TAPPEINER ... ... Deutches Archiv. für klin. med., Bd. xxix, 1881.
„ ... ... Virchow's Archiv., Bd. lxxiv, 1878.
„ ... ... *Ibid.*, Bd. lxxxii, 1880.
VERAGUTH ... ... Archiv. f. exp. Pathol., Bd. xvii, p. 261, 1883.
WEICHELSBAUM ... Wiener Med. Jahrb., 1883.

Contagiousness of Phthisis.

ALISON ... ... Archives Gén. de Méd., Sept. 1885.
BEHNKE AND NAUNYN Die verbreitung der Lungentuberkulose durch Kontagion, Königsberg, 1884.
BUDD ... ... Lancet, vol. ii, p. 452, 1867.
„ vol. i, 1878.
COHNHEIM ... ... Die Tuberkulose vom Standpunkte der Infectionslehre, Leipsig, 1880.
DESTRÉE ET SLOSSE ... La Contagiosité de la Tuberculose Clinique, Bruxelles, i, p. 669, 1887.
FLEMMING ... ... Brit. and For. Med. Chir. Rev., Oct. 1874.
„ ... ... The Influence of Heredity and Contagion in the Propagation of Tuberculosis, 1883.
MUSGRAVE-CLAYE ... Étude sur la Contagiosité de la Phthisie pulmonaire, thèse de Paris, 1879.
THOMSON ... ... Edinb. Med. Journ., Oct. 1888.
VILLEMIN ... ... Études sur la Tuberculose, Paris, 1868.
„ ... ... Bull. de l'Acad. de Méd., Paris, t. xxxii, 1886.
VISEUR ... ... Rec. de Méd. Vét., 1873.
WEBB ... ... The Contagiousness of Phthisis, 1885.
WEBER, HERMANN ... Trans. Clinical Soc., vol. vii.
ZUNDEL ... ... Rec. de Méd. Vét., 1874.

Influence of Overcrowding and want of Ventilation.

BRYSON ... ... On Epidemic Pleuropneumonia in the Mediterranean Fleet, Trans. Epid. Soc., vol. ii, p. 142, 1863-64.
GREENHOW ... ... Third Rep. of the Med. Off. to the Privy Council, App. iv, 1860.
„ ... ... Fourth Rep. of the Med. Off. to the Privy Council, App. vi, 1861.
MACKELEAVE, J. ... Med. Times and Gaz., p. 227, Aug. 1886.
RANSOME ... ... Trans. Epidem. Soc., N. S., vol. v, 1886-87.

Influence of Occupation.

GREENHOW, E. H.	...	The Prevalence of certain Diseases in different Districts in England and Wales: Report to the General Board of Health, 1858.
POLLOCK	...	The Elements of Prognosis in Consumption, 1865.
THACKRAH, T.	...	The Effect of Arts, Trades, and Professions as affecting Health and Longevity, London, 1832.
Report	...	On the Staffordshire Potteries: L. Gov. Board, 1872.
„	...	Of a Commission to inquire into the effects of Labour in Women and Children employed in Textile Factories, 1873.
„	...	Of Med. Off. to the Privy Council, 1860-61-63.

Further reference to works will be found in the following :—

		Dictionnaire de Médicine et de Chirurgie pratiques (art. Tuberculose), t. xxxvi, Paris, 1869.
WALDENBURGH	...	Die Tuberkulose, die Langenschwindsucht, und Skrophulose, Berlin, 1869.
JOHNE	...	Deutsche Zeitschrift für Thiermedicin, Bd. ix, p. 1, 1883.
WEICHSELBAUM, A.	...	Centralbl. f. Bakteriologie u. Parasitenkunde, II Jahrg., 1888, Bd. iii, Nos. 16 to 24 inclusive, or Translation in Public Health, Sept. to Dec. 1888.
WOODHEAD AND HARE		Pathological Mycology, Section I (Methods), 1885.
		Progress Report of the Board appointed to inquire relative to the existence and extent in Victoria of the Disease in Cattle known as Tuberculosis, Melbourne, 1884 and 1885.

ON RABIES: ITS TREATMENT BY M. PASTEUR;

AND ON

THE MEANS OF DETECTING IT IN SUSPECTED CASES.

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(*Read: February 12th*, 1889.)

THE lecture this evening being on the subject of M. Pasteur's work, it is fitting that what I have to say should be preceded by a brief sketch of the pathology of rabies, since it is owing to his extraordinarily brilliant investigations that we are now rejoicing in full possession of such particulars as make completely clear what till three years ago was somewhat obscure and apparently contradictory. Moreover, I could not treat (as I wish to do for the sake of time) some points by simply scheduling the results of investigations unless I supplied you with the connecting facts.

Rabies is an acute specific disease, the virus of which behaves so exactly like a micro-organism that there can be no doubt that it is indeed one. Micrococci have been described by all observers as occurring in such numbers and positions as to suggest a causal nexus, but with the exception of a single doubtful observation by Fol, these have never been isolated in cultivation and proved to be pathogenic. While, therefore, henceforth speaking of the cause of the disease as a virus, I wish to be understood as considering it established that that virus is a microbe.

We will now proceed to consider the conditions under which the virus at present exists and from time to time produces its destructive effects. Like most pathogenic organisms, it is transmitted from one living animal to another living animal; but if exposed to drying, extremes of temperature, absence of pabulum (probably in rabies necessarily living tissue), it rapidly becomes inert, that is, dies. The practical application of this fundamentally important fact is obvious, namely, that if we could at one blow destroy all animals infected by the disease the malady would immediately become extinct. (I

need hardly say that no case of asserted "spontaneous" generation of the disease bears investigation.) It is a fortunate thing that this rapid destruction of the virus should evidently occur, since, as it frequently happens, that the saliva of a rabid dog is dropped upon the streets, etc., the prevalence of the infection would be much greater than it now is. The virus attacks all animals, is more deadly in its action upon young individuals, and seems to acquire a specially virulent quality during its development in the cat and wolf. Insistence upon the first of these points is important, as in a recent trial the counsel for the plaintiff asserted that horses could not take the disease, and the judge appeared to acquiesce, although every text-book on the subject describes such cases. In 1887, 4 horses, 11 cattle, 8 sheep and swine were returned as affected with the disease in England, and in the same year 99 cattle, 13 horses, 1 mule, 21 sheep and swine were affected in France. No doubt these figures are much smaller than the actual facts, inasmuch as the failure to recognise the disease has lately been shown to occur more frequently than is desirable. In all cases the natural mode of transmission of the virus from one animal to another is by subcutaneous inoculation; for example, by being bitten or by the reception of the saliva on to a recent scratch or wound.

I now come to that most important point, the incubation period. Upon this naturally hangs a great deal, and it must therefore be considered at some length. First, let us see what, accurately (that is, experimentally) measured, is the universal incubation period, that is the period elapsing between the inoculation and the appearance of (*a*) excitability (if the disease assume the maniacal form); (*b*) dulness (if the paralytic form).

The shortest time is six to eight days if the inoculation be subdural; eight to nine days is also not infrequent; but while seven days is an accurate mean, that, though of much practical interest, need not concern us specially for the present. We will take the minimum of six days.

I have said that this has been found with subdural inoculation. Now, cases of such extraordinarily short incubation period have been stated to occur in young children from bites upon the face. On account of the age and part attacked this is obviously quite possible, and not only is credence to be given to such a statement, but this interval also serves as a critical point in testing the value of M. Pasteur's treatment. Any case submitted to treatment after six days had elapsed should clearly fall under the category of "possibly too late". And, strictly speaking, such cases should be placed in a class

by themselves, the death-rate of which would be specially high. That this most particularly concerns patients in this country attacked by a dog, certified by a veterinarian to be rabid, is seen in the fact that of the few English patients who have died after the Pasteurian treatment, most belong to the "too late" class. Such a case, for instance, was that of Lord Doneraile, who arrived at Paris eleven days after the bite, and who refused to go through the treatment ordered.

The next incubation period of interest is the mean for subcutaneous inoculations, as, for instance, through bites received in the street. The evidence is nearly unanimous in placing this at six weeks.

Finally, the maximum period is one which of course we are all extremely desirous to see determined, since its uncertainty constitutes the most painful aspect of the torturing anxiety from which these patients suffer. Unhappily, we can only say that it appears to be actually as much, in some cases, as two years.

Symptomatology.—The symptoms of rabies vary in degree in different animals, but their sequence is identical as follows: 1, Mental disturbance (excitement, delusions); 2, hyperæsthesia, spasms; 3, hebetude, with mania and melancholia; 4, paralysis. Death, customarily preceded by syncope or coma.* Clinically speaking, the disease assumes commonly (1) a mainly explosive form, (2) a mainly paralytic form. Until the last few years, the latter form was not recognised as a clinical entity in man, although numerous cases have been published; and it was no doubt owing to the general ignorance of the frequent existence of this kind of the disease that M. Peter and others made an absurd series of attacks on M. Pasteur, asserting that paralytic rabies was introduced by his method of treatment. I now throw photographs of different rabid animals on the screen, and you see the various stages of the malady.

I will now proceed to the discussion of M. Pasteur's mode of attempting to cure, or rather, to prevent the development of this malady. The cases he receives at Paris are divided into classes, according as to whether the evidence of the rabidity of the dog rests upon that of experimental inoculation, on veterinary certificate, or only a general report. Although the death-rate in the two latter classes amounts to nearly that in the first class, I shall only allude to the first class, and deal in the following remarks with those persons unquestionably the

* The sudden arrest of the heart, which is so very common in this disease, seems in some cases to be due to extreme reflex excitation of the bulb.

prospective victims of rabies. Hence, we are concerned with but one death-rate—namely, that of groups of persons bitten by rabid dogs, the rabidity being established by the fact of one or more individuals of the group dying of rabies or hydrophobia. Now the true death-rate among persons thus bitten amounts to 15 per cent. This important figure is the result of analyses by three different and independent observers.

Leblanc, in 1873, carefully analysed the results of cases of rabies known to him personally, and found that the death-rate in unquestionable cases was almost 14 per cent.

Dujardin-Beaumetz, "Rapport Spécial au Conseil d'Hygiène et de Salubrité du Département de la Seine, 1887", found that seven deaths occurred among forty-four persons attacked by rabid animals, and not treated by M. Pasteur, the mortality thus being 15.90 per cent.

Myself: Through the kindness of Colonel Moorson, chief constable of Lancashire, I obtained the following facts. Six deaths occurred among thirty-six persons attacked; the mortality therefore was 16.6 per cent.

There can be no doubt, therefore, from examination of these figures, independently ascertained, that the true death-rate among persons bitten by indubitably rabid dogs, and not treated by M. Pasteur, is, on the average, about 15 per cent. With this definite fact before us, we learn that in exactly the same class (Class A) of patients M. Pasteur has obtained a death-rate of only 1.36 per cent. Though the success of his treatment is thus assured, it will not be uninteresting, I think, to dwell upon its scientific bearing.

Treatment.—Since the details of the pathology of rabies were dubious until M. Pasteur cleared up the whole subject, no treatment worth the name was ever proposed. In fact, the only attempt made was the lowering of the hyperexcitability of the congested reflex centres by empirical dosing with narcotics. While, of course, in no sense curative, I nevertheless believe that, after the appearance of the first symptom, this, for the sake of humanity, is the only justifiable course to be pursued.

M. Pasteur from the first recognised the true nature of the malady, and realised that the only possible mode of coping with the virus would be by attempting to arrest its development within the body. Arguing that it, the virus, was a microbe, he considered that we should be able to obtain the waste products of its metabolic processes, and that then such waste products (known to inhibit the growth of organisms) might be injected in sufficient quantity to check their pro-

gress. Every fresh investigation shows the clearness of M. Pasteur's insight into this question, since the validity of his theory receives daily confirmation from the record of the behaviour of the virus of other infective diseases.

The merit of proving the correctness of this theory by perfectly independent research is due to Dr. Wooldridge, who isolated a chemical substance which protected rabbits against anthrax. M. Pasteur believed it possible to obtain these waste products (unaltered by any mode of chemical extraction) by destroying the virulence of the microbe and not the protective substances. He therefore subjected portions of the central nervous system—that is, spinal cord by preference—to the combined action of heat and drying. By inoculation he discovered the rate of loss of virulence, according to the heat employed, etc. By injection into dogs of successive quantities of the material, he found that they became proof against the bites of rabid dogs, and at the same time, by their remaining in health, that they were in no wise affected injuriously by the treatment. Having in view that the average length of the incubation period of subcutaneous inoculation, as in the streets, was no less than six weeks, it seemed to M. Pasteur that, if the nature of the case were recognised at once, the development of the virus in the body of a human patient might be prevented, if it were only possible to inject sufficiently rapidly a large quantity of the chemical protective substance. This he proceeded to do in the manner I have already indicated, and I shall only dwell upon the two great divisions into which this subject may be divided. These divisions are what are commonly known as the "simple treatment" and the "intensive treatment" respectively.

The "Simple Treatment".—By this, as you know well, M. Pasteur meant the injection of small quantities of the protective substance contained in cords, dried not less than from five to seven days, and this treatment he employed only in apparently mild cases.

The "Intensive Treatment".—This consists in injections, frequently repeated, of a considerable quantity of the substance from cords dried for shorter periods than in those of the simple treatment. This intensive treatment was, perhaps, the part of the method most attacked. It was, indeed, asserted by M. Pasteur's irresponsible opponents to be fatal in operation. The actual facts, however, are as follows: The only case completely investigated in which death was not averted by thorough employment of the method was that of the patient Goffi. This case I have fully published with Dr. Bristowe in the Clinical Society, November 1888, and we

there showed that the death was to be attributed to the cat-bite and not to the treatment. The intensive treatment is employed for severe cases, and, consequently, especially used in Russia, where the excessive prevalence of the disease and the severity of the wolf-bites make the statistics particularly valuable.

In the following table I contrast the results of treatment by the old or simple method and by the latter or intensive plan.

Table showing the contrast between the Old or Simple Treatment and the Intensive Treatment.

Simple Treatment, 1886.	Intensive Treatment, 1888.
Odessa ..... 3.39 per cent....	0.64 per cent.
Warsaw ... 4.1 „ ...	0 per cent. (although figures include 16 months' work, and 30 individuals bitten in the face, and 4 by wolves).
Moscow ... 8.4* „ ...	1.60 per cent.

It is evident that the intensive treatment is very successful in coping with the worst cases, and that, instead of being itself a source of death, as asserted by those who gain notoriety and subsistence by vilifying and misrepresenting scientific progress, it is a powerful agent in saving life.

Summary.—To sum up, it is clear that M. Pasteur has succeeded in diminishing the percentage of risk in being bitten by a rabid dog from 15 to 1.36, and that this result is obtained by injecting a chemical protective substance.

Means of recognising the Disease in Suspicious Cases.—This is a point of considerable importance to medical officers of health and veterinary inspectors, since they are frequently called upon to authoritatively decide as to whether an animal is or has been suffering from rabies. For the correct detection of the disease in the living animal I need only refer you to textbooks and to the few remarks which I have already made on that point. But supposing one is shown a dead animal supposed to have been rabid, upon what is reliance to be placed for a correct diagnosis? Clearly (1) the *post-mortem* appearances; (2) the result of the method of experimental inoculation discovered by M. Pasteur. (1) *Post-mortem* appearances: It is very curious to see the amount of confusion and doubt concerning this branch of the subject which still seems to exist in some minds. The facts really are extremely simple and straightforward. In the first place, an animal may be killed soon after the disease has

* This unusually high rate was found to be also due to imperfections in the mode of preparing the cords for the inoculation material.

shown itself by the initial symptoms—that is, on the first or second day of the illness. At this stage the virus will not have had sufficient time to produce the characteristic changes in the tissues, and therefore nothing but a few patches of congestion may be found here and there in the central nervous system. The same negative result will also attend similar investigations in the cases of human beings who commonly die in the early stages from syncope. It is neglect of these very obvious facts that has led to the oft-repeated assertion that rabies has no characteristic morbid anatomy. In such cases, correct diagnosis rests alone upon experimental inoculation. But in a fully-developed case of rabies running its complete course the following changes, gross and minute, are to be observed. I shall simply sum them up categorically, and in illustration show you a few photographs upon the screen. For those which are microscopic I am indebted to my friend Mr. Boyce, they being made by him from my specimens.

Central Nervous System.—Early stage, congestion, followed later by exudation of leucocytes into the perivascular lymphatics, and interstitial neuroglia. Hæmorrhages also are frequent. (All as previously described by Allbutt, Gowers, and others.)

Peripheral Nervous System.—Congestion.

The changes in the central nervous system are frequently concentrated in localities, so that the whole must be carefully examined.

Respiratory System.—Congestion of laryngeal mucous membrane; congestion of tracheal mucous membrane; frequently patches of broncho-pneumonia.

Alimentary System.—Tongue furred and dry (especially in paralytic cases); pharynx congested, markedly at root of tongue. Stomach congested; hæmorrhages in the mucous membrane, specially in the cardiac end. Contents, coffee-ground material and foreign bodies.

Renal System.—Bladder distended in paralytic stage.

2. *The second method,* or that of inoculation, performed according to M. Pasteur's description, is the most valuable, since it forms an incontestable evidence of the presence or absence of the disease.

The extraordinary statements made by some writers, such as Spitzka, etc., to the effect that the symptoms of rabies in a rabbit are not peculiar or in any degree characteristic, and can be evoked by non-rabic material, etc., I only allude to because they are frequently paraded in our journals by writers who have obviously never consulted the original de-

scription of these so-called experiments, nor are possessed of any personal experience of the disease of which they treat. I here show you a photograph of a rabbit with rabies following a bite from a rabid dog of the streets. The paralysis is well marked. Suffice it to say that the experience of every careful observer on this subject entirely annihilates such loose and incorrect assertions.

Method.—The following is the method now generally adopted. About two inches of the upper cervical region of the spinal cord is removed as soon as possible after death, and placed in 10 per cent. solution of glycerine and water. This, while preventing decomposition if the fluid is frequently changed, does not destroy the specific rabic virus. When it is convenient to inoculate, a piece of the cord is washed in recently-boiled distilled water, then crushed in a glass mortar in *bouillon*, and injected subdurally through a very small trephine opening. The whole operation can be performed in a few minutes under local anæsthesia, produced by the application of 5 per cent. carbolic acid, which at the same time ensures the immediate union of the little wound. In some hundreds of cases I have never yet seen suppuration occur.

The animals most suitable for the inoculation test are rabbits, since in them the disease assumes a paralytic form, as a rule, from the commencement; and, as we know from cases in man, this form, besides being painless, terminates early by coma. As a rule, the first symptom appears on the fourteenth day, after which the animal commonly dies in four days. I think, however, that in those cases where the animals remain healthy they should be kept for inspection for three months after inoculation. I have carried out this method in thirty-six specimens sent me for diagnosis. Of the thirty-six, twenty-five, or nearly 70 per cent., proved to be genuine rabies.

In the present outrageous state of the law it is, however, impossible for any medical officer of health or veterinary inspector to perform this simple test, unless he is possessed of (1) a licence, (2) a certificate B, (3) and performs the experiment in a registered place, under 39 and 40 Vict. How long the profession and the public are willing to keep hygiene and science thus hampered remains to be seen.

Although M. Pasteur's mode of treating rabies has met with rather more virulent opposition than his mode of treating anthrax, it is fortunate that he has seen the adoption of the latter and the gradual perfection of the former.

At the present time this country is content to accept the

charity of M. Pasteur, the very large majority of patients sent from England having made no return (in most cases they have been in poor circumstances) for the treatment received. Not only is our present position in regard to this disease humiliating for this reason, but the actual need for treatment ought not to exist in Great Britain, and it is a scandal that it does so exist. Clearly if by (1) proper measures we prevent its importation into the country from infected lands abroad; (2) by muzzling we prevent dogs from communicating the disease by biting each other and other animals; (3) by destroying stray animals, notably dogs and cats, we prevent the frequent accumulation of sources of ready infection, the disease must die out, since, as I have already shown, the virus is apparently transmitted from living animal to living animal. But the actual proof of this is now present in overwhelming degree: I need only give you two or three examples.

This photograph shows you the result of applying such measures as I have indicated in Berlin. You see the death-rate among men and cases among dogs were rapidly rising when the police regulations were enforced, and the disease was temporarily stamped out; a number of years later it reappears by introduction from without, and by confessed neglect of the regulations, but only to be again eradicated by the former means, and this time apparently permanently, for the same laws having been made practically universal throughout the German Empire, this disease is now becoming extinct, and would be so at once were it not constantly being imported over the Russian frontier.

In Scandinavia, formerly decimated, rabies is now unknown, by reason of their strict adherence to restrictive legislation. Paris furnishes us with the most recent evidence, a curve published by Dr. Grancher showing the immediate effect of the laws in cutting down the disease by merciful extermination of the already infected.

The records of the provinces, especially Nottingham (as shown by Dr. Whitelegge's figures) and Lancashire (report by Colonel Moorsom), exhibit very strikingly the fact that rabies prevails or disappears as the regulations are respectively neglected or properly enforced. But by far the most striking results are those obtained here in London, although they illustrate in a lamentably striking manner the folly of applying laws to isolated districts, which only purge that district, and do not provide against the reintroduction of the evil from the surrounding country.

Rabies in London destroyed twenty-seven lives in 1885.

The authorities then put on the muzzle, and ordered the slaughter of stray and unclaimed dogs; the result being, that by the end of 1886 it was practically extinct. The regulations were then allowed to lapse in accordance with the present imperfect legislation. Since that moment the disease has been steadily creeping into London again, especially from the south and south-west suburbs; in 1886-87 it raged among a herd of deer in Richmond Park, destroying some hundreds of them; and since that it has also been epidemic in Kingston, Surrey, on the borders of the park. Deaths among human beings are now gradually becoming more numerous. I have myself seen two cases, and had to do with a third, during the last three months. These cases came from different parts of London, so that the disease is as usual steadily becoming universal.

The Select Committee of the House of Lords, which reported on this subject in August 1887, by the unfortunate influence of two of its members, Lord Onslow and the late Lord Mount Temple, stated that they considered it better to leave to the local authorities the initiation of necessary preventive measures; but they say, para. 26, that "the time may come when the public may call upon the Privy Council to act on its own authority throughout the kingdom." That that time has come when the public ought so to call, indeed, has always been present, is obvious from such a history as that of London, which I have just detailed to you, and we can only hope that the public interest may be sufficiently awakened to destroy for ever, as it easily might, so horrible a scourge.

The legislative machinery for this end has been drafted in the form of a workable Act by the Society for the Prevention of Hydrophobia and the Reform of the Dog Laws. Whether any Government will think it worth while to take the matter up, and stamp out once and for all, this, the most easily eradicated and yet the worst of diseases, remains to be seen. That it should exist among us is a standing disgrace to our civilisation.

A BRIEF REVIEW OF OUR KNOWLEDGE OF THE RELATION OF MICRO-ORGANISMS TO DISEASES IN MAN.

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(*Read: March 13th*, 1889.)

When you did me the honour, Sir, to ask me to read a paper before the members of this Society upon the relationship of micro-organisms to disease, so far as our knowledge has extended to enable us to speak with some certainty as to such organisms being the direct cause of certain well-known specific infective disorders, I was thoroughly alive to the importance of the subject, and regretted that for such a review you had not chosen one better able to deal with it.

Such a relationship is now, I think, on all hands, admitted to be very intimate; and although it may not be of such a universal nature as some perhaps would have us believe, yet, so far as many diseases are concerned, it has been abundantly shown to be of a most direct and positive nature.

A knowledge of what is known regarding these minute bodies is not only necessary for pathological study, but for the rational treatment also of infectious diseases; in that department of medicine known as preventive, the special value of such knowledge is very evident. So long as the cause of a disease is unknown, the views held as to its origin must be vague, and the measures adopted against it frequently ineffectual; but when the cause is known, and especially when it can be isolated and its life-history studied, together with its behaviour outside the body, its mode of entrance into the system, and the best methods for destroying it, then indeed, and only then, can measures be adopted both precise and effectual.

A medical officer of health should, however, not alone be conversant with the literature on this subject, but should have a practical acquaintance with the best methods of research. It is to be regretted that opportunities have not been afforded in this country such as those which exist in Berlin for health-officials to obtain this practical knowledge;

and it is a subject for congratulation that measures have now been taken to remove, in some measure, this defect.

The bacteria were for a long time included in the animal kingdom; but, from a more precise study of their morphological and physiological characters, their modes of reproduction, and the obvious relation which they bear to the algæ on the one hand, and to the fungi on the other, have led observers to regard them as the lowest stage of plant life. They are divisible into three main groups: the first, where the cells are round, when they are termed cocci; secondly, where the cells are more or less elongated, varying from short rods, which are twice as long as they are broad, to long threads—these are the bacilli; thirdly, when the organisms are elongated and twisted, like a corkscrew—these are called by Cohn spiro-bacteria, and by him are further divided into the spirochætæ—where the rod is flexile and long, and the turns of the screw close together—and the spirilla proper —where the rods are stiff, shorter, and the turns of the screw wider apart.

In all investigations of the relation of micro-organisms to disease, it is necessary to bear in mind that in no case can it be said to have been proved that a particular infectious disease is due to a particular micro-organism, if any one of the following conditions laid down by Dr. Koch remains unfulfilled.

1. The micro-organism must be found in the blood, lymph, or diseased tissues of man or animal suffering from, or dead of, the disease.

2. The micro-organisms must be isolated from their nidus, from the blood or tissues, as the case may be, and cultivated in suitable media, *i.e.*, outside the body, and by such means as will effectually exclude the accidental introduction of other micro-organisms. These pure cultivations must then be carried on from one cultivation to another through several successive generations, in order to obtain them free of every kind of matter derived from the animal body from which they were taken in the first instance.

3. A pure cultivation thus obtained must, when introduced into the body of a healthy animal susceptible to the disease, produce the disease in question; and

4. It is necessary that in this inoculated animal the same micro-organism should again be found.

These points naturally suggest the sequence in which the various processes must be adopted in the practical study of micro-organisms associated with disease; but, in reference to the first, it is well we should note that great differences

exist as to the presence of the organism in the blood and in the tissues; in some cases the micro-organism, although present in the blood, cannot be detected in the tissues; whilst in others, although present in the tissues, cannot be found in the blood. Whether these differences depend upon defects in our methods of examination, as is very probable, remains yet to be satisfactorily settled.

We will proceed now to the consideration of the diseases in question.

Tuberculosis.—The etiology of this disease is of the greatest moment and highest possible interest, and, as we all know, it is to the brilliant researches of Professor Koch of Berlin that we are indebted for the exact knowledge we now have of this disease.

It was some time since that Buhl pointed out the connection which existed between miliary tuberculosis and primary cheesy foci, and suggested that general tuberculosis was to be regarded as a disease due to the absorption of a virus originally present in a primary cheesy nodule, and causing self-infection; the way in which the virus was distributed through the body being explained, in great measure, by Ponfick's discoveries relative to tuberculosis of the thoracic duct, and Weigert's detection of tubercle in the walls of the veins. Such facts, however, whilst bearing upon the question of the diffusion of the tubercular virus throughout the body, did nothing to show that the virus was communicable from one person to another, rendering the disease an infectious one.

Many attempts were made, towards the end of the last century, to artificially produce tuberculosis, without result. The first successful experiments were made by Klencke, in 1843, who induced extensive tuberculosis of the lungs and liver in rabbits by inoculation into the veins of the neck of portions of miliary and infiltrating tubercles from man. These experiments were, however, not continued, and were consequently soon forgotten. Later, Villemin undertook a series of investigations on the subject, working throughout with great care and thoroughness, inoculating not only with tubercular matter obtained from human beings, but also from cases of bovine tuberculosis. These researches, not only from the methodical character and great number of the experiments, but also from the employment of suitable control experiments, appear to have conclusively proved the question in favour of the infective theory. These experiments were repeated by other observers; the adherents of the infective theory seeking to improve the details of the

experimental methods, and its opponents, on the other hand, striving to prove that tubercular material contains no specific virus, and that true tuberculosis could be induced by inoculation with non-tubercular matter. To the decision of this question Cohnheim and Salomonsen contributed greatly, by selecting for inoculation the anterior chamber of a rabbit's eye, by which means a separation of the cases is made into those in which successful inoculation with tubercular material has been accomplished, from those in which some other infective material has been introduced with the tubercular virus; for with this latter material subcutaneous inoculation often causes a more or less widely diffused cheesy infiltration, not unlike that of tubercle, whilst in the eye a general inflammation of short duration is produced, which cannot be mistaken for the slow characteristic development of tuberculosis following inoculation. On the other hand, the course of a successful tubercular inoculation is very characteristic. After a somewhat long incubation period, single grey, hardly perceptible nodules appear in the iris, starting from the site of inoculation; these gradually increase in size, and become yellowish in the centre; they caseate, and generally exhibit all the characteristics of the true tubercular nodule; later on, the whole organism becomes affected—the neighbouring lymphatic glands, the lungs, spleen, liver, and kidneys. In no case did tuberculosis of the iris follow an inoculation with non-tubercular material, and in no case has spontaneous tuberculosis of the iris ever been observed in rabbits. Such a method of infection, therefore, presented obvious advantages over others, establishing, as it did, the fact that tubercular materials apparently differing widely from each other were characterised by one and the same specific contagium; but no decision could be obtained as to the nature of the contagium, whether it consisted of specific organisms gifted with constant properties, or whether, on the other hand, it was composed of particles of an organised or unorganised nature arising only under certain abnormal conditions within the body.

Following the conditions laid down as necessary to establish the parasitic nature of a disease, the efforts of Professor Koch were directed in the first place to show the presence of a pathogenic organism, and subsequently, by isolation and inoculation experiments, to demonstrate its causal connection with the disease.

He began his efforts by the examination of recently developed grey tubercle from the lungs of animals killed three or four weeks after inoculation, in which material the virus

might confidently be expected to be present; sections of such organs, hardened in absolute alcohol, were examined, together with cover glass specimens of the crushed grey tubercle, but all such attempts to discover the presence of micro-organisms failed. At this stage advantage was taken by Dr. Koch of experience previously gained, which was to the effect that in certain cases the deepest staining and clearest differentiation of bacilli from the surrounding tissues were obtained by using dyes of alkaline reaction; and of all the ordinary aniline dyes, methylene blue, bearing the freest addition of alkali, was chosen (to a watery solution of it caustic potash was added so long as the dye remained clear, and no precipitate was produced). When cover glass specimens were exposed to this staining fluid for twenty-four hours, very fine, rod-like bodies were detected for the first time in the tubercular material, which further observations showed to possess the power of multiplication and spore formation. The method subsequently adopted for demonstrating the presence of these organisms was to make cover glass preparations dried in a very thin layer, and heated two or three times in the flame of a Bunsen burner, or to take very thin sections of organs thoroughly hardened in alcohol, and stain them with a solution consisting of aniline water 100 c.c., alcoholic solution of methyl violet or fuchsin 11 c.c., and 10 c.c. of absolute alcohol.

The preparation should remain in the staining fluid twelve hours, the staining being facilitated by slightly warming the solution; subsequently the preparation should be immersed in dilute nitric acid (1 to 3) for some few seconds, then rinsed for some minutes in 60 per cent. alcohol, and placed in a dilute solution of vesuvin or methylene blue, again washed in 60 per cent. alcohol, dehydrated in absolute alcohol, cleared with cedar oil, and mounted in Canada balsam.

This method of staining is of importance, so far as the tubercle bacilli are concerned, for no other bacillus, with the exception of the leprosy bacillus, gives the same colour reaction. The bacilli of tuberculosis and leprosy resemble each other in various ways. Still, a distinction can be observed, even in this process of staining; for whereas the bacillus of leprosy can be stained by the same method as the tubercle bacillus, the converse does not hold good; the former stains by Weigert's plan for colouring nuclei, the latter does not.

The tubercle bacilli appear as small rods of the length of a quarter to half the diameter of a red blood cell. They are not quite straight, but show slight breaks or bends, and often have a tendency to curve.

In tubercular organs the bacilli are variously distributed; they are generally found where the tubercular process is just beginning, or where it is rapidly spreading; they are within the cells near to the nucleus. A cell may contain two, or three, or more bacilli; sometimes they are much more numerous, being arranged parallel to each other in closely packed heaps. At this stage the relationship which previously existed between the bacilli and cells cannot be made out, because the cells, having undergone considerable change, are on the point of death, whilst the nuclei are also undergoing disintegration and transformation into irregularly shaped particles. These become less numerous, until at last all that is left is a homogeneous cheesy mass, which will not stain, and in which all the cells originally present are dead. Few bacilli are present, for they likewise perish, or pass on to the spore forming stage; and in so doing lose their capability of staining, the presence of such spores being revealed by the infective properties of the cheesy substance which contains them. It is important to note the order of these changes. The tubercle bacilli are the primary phenomena; these are surrounded by cells, which, undergoing decay and death, form the caseous masses. The relationship of the bacilli to the giant cells is also noteworthy, although it is now known that giant cells are present in other pathological processes, and are not a specific product of tuberculosis.

As soon as giant cells appear in a tubercular mass they are found to contain the tubercle bacilli. In slow progressing tubercular processes, when the bacilli are present only in small numbers, they are found almost exclusively in the giant cells; whilst in the more rapid processes, the bacilli are present in much greater numbers, the giant cells containing as many as fifty or sixty bacilli in one cell; and it is also interesting to note that a kind of antagonism exists between the nuclei and the organism, the latter being found near the periphery of the cell, or as far as possible from the nuclei. When the bacilli multiply rapidly, they encroach upon the nuclei and rupture their walls, with the result that they fall to pieces and cause destruction of the cell.

Nineteen cases of miliary tuberculosis were examined by Dr. Koch, and in no case were bacilli absent from the nodule; the smaller and more recent the nodule, the larger the number of bacilli present; and in the larger nodules, which showed caseation in their centre, the number of bacilli were found to be decreased. In the liver and spleen of these cases the bacilli were found almost exclusively in the giant-cells; in the meninges of the brain, the tubercles

were found to be rich in tubercle bacilli, frequently in the neighbourhood of the smaller arteries, and sometimes in the interior of the vessels themselves.

Of pulmonary phthisis he examined twenty-nine cases, and detected the tubercle bacilli in all; and in no case in which he examined the sputum from tubercular lungs did he fail to detect the organism; so, as pointed out by him, their demonstration is a matter of great diagnostic importance. Frequently such bacilli are found to contain spores. The organism was likewise detected in the tubercles connected with ulceration of the intestines; and in the adjacent mesenteric glands the bacilli were found in dense masses, chiefly at the periphery of the caseous portions. Lichtheim, Gaffky, and others, have also shown that in the evacuations of phthisical patients, with tubercular ulceration of the intestine, they are also present in large quantities, their peculiar staining properties rendering their detection easy.

In addition to the foregoing, Koch has found the bacillus in cases of tuberculosis of various organs, such as the tongue, kidney, etc., in scrofulous glands, in the granulation tissue in the neighbourhood of tuberculous joints and bones, in the tuberculosis of animals, bovine, equine, in swine, goats, sheep, fowls, monkeys, guinea-pigs, and rabbits.

From these facts, therefore—that the tubercle bacilli are always present in tuberculosis, and are found under no other morbid conditions; that they precede, both as to place and time, all the special pathological changes of that disease; and that their number, their appearance and disappearance, are in direct relation with its course—the conclusion was to be drawn that the tubercle bacillus stood to the disease as its direct cause, and not merely as a chance accompaniment.

To render this conclusion a certainty, it was necessary to isolate the organism from the diseased organs; to cultivate it outside the body, and study its cultural peculiarities; and, lastly, by inoculations with the bacilli freed from admixture with the products of disease, to artificially produce tuberculosis in animals.

Koch obtained pure cultivations by inoculation of blood-serum with material from the interior of lymphatic glands taken from a recently killed tubercular guinea-pig; or from small superficial pulmonary cavities in the human subject, the outer wall of which, after treatment with corrosive sublimate, was removed with hot instruments; or from bovine tubercles. From whatever source the material is obtained, the inoculated tubes must be kept at a constant tempera-

ture of about 37° C. The growth takes place slowly, no growth being visible before the tenth or fifteenth day, when small whitish points or spots appear on the surface; these, if sufficiently numerous, soon coalesce and form a thin, greyish white, lustreless covering on the serum. Other noteworthy points are, that the growth does not cause liquefaction of the serum, nor does it penetrate its substance, but always remains loosely attached to the surface; the growth also takes place in agar-agar peptone mixture, and on solidified hydrocele fluid. The cultures attain their maximum development in about four weeks, and remain unchanged after that time.

It was proved by numerous experiments that, at a temperature of 42° C., no growth occurred in three weeks; at 30° there was but little growth; and between 28° and 29° no growth at all; the best temperature being from 37° to 38°. Owing to this fact, it is evident that the tubercle bacilli do not thrive in the outside world in temperate climates; and, considering also the narrow scope tubercle bacilli have as regards soil, the organism can only be considered as a true parasite, finding the conditions necessary for existence alone in the animal or human organism.

Inoculation experiments with tissues containing tubercle bacilli were carried out, either by inserting in a small pouch like wound of the abdominal wall of guinea-pigs, or in the anterior chamber of the eye in rabbits, small fragments of tissue from various organs in cases of human miliary tuberculosis from phthisical lungs, strumous joints, glands, etc. In this way Koch infected 79 guinea-pigs, 35 rabbits, and 4 cats, and in all, without a single exception, tuberculosis resulted, and in all the characteristic structure of tubercle and the presence of the tubercle bacilli were demonstrated.

Further infection experiments were carried on under the strictest precautions, and with the greatest attention to detail, by the inoculation of bacilli in a pure state, quite isolated from all elements of the body.

In all, some 217 animals were thus infected, made up of 94 guinea-pigs, 70 rabbits, 9 cats, and 44 field mice; and these, without exception, became tubercular. The infection was accomplished by subcutaneous injection, injections into the anterior chamber of the eye, into the peritoneal cavity, into a large vein, and by inhalation. In these experiments, therefore, made with pure cultures, tubercle bacilli, and tubercle bacilli only, could have been the cause of tuberculosis; and this proves tuberculosis to be an infective disease, depending on the presence of tubercle bacilli. Further, in

all cases of tuberculosis tubercle bacilli are present; and the manner of their appearing further proves that they stand to the disease as cause.

These observations of Koch have been generally confirmed by numerous observers—notably, by Weichselbaum, who discovered the bacilli in the blood of a man suffering from acute miliary tuberculosis, and by Mr. Watson Cheyne in this country.

Leprosy.—The connection of a bacillus with this disease was first pointed out by Hansen, in a report made by him to the Medical Society of Christiania in 1874; these observations were subsequently confirmed by Neisser, who described the effect of various staining agents upon them. The organisms are found in the mucous membrane of the mouth, pharynx, and larynx, in the neoplasms of the skin, in the interstitial deposits in the peripheral nerves, etc., and in the lymphatic glands, spleen, and liver. In the skin they are present in the circumscribed nodular formations, as well as in the more diffuse infiltrations. They are found almost entirely in the large round cells described by Virchow as lepra cells. These cells exceed in size an ordinary white blood-cell, and they contain several nuclei. The bacilli are either equally diffused throughout the cells, or they are collected in bundles consisting of six or seven bacilli lying parallel to each other. They are not often found in the connective-tissue spaces between the cells; but their presence has been demonstrated in the blood-vessels.

The bacilli can be stained with fuchsin or with Ehrlich's acid solution of eosin-hæmatoxylin, and they are found to be very delicate rods, sometimes pointed at both ends, 0.004 to 0.006 mm. long, and less than 0.001 mm. thick; in other words, one-half to three-quarters the length of a red blood-cell, the breadth being about one-quarter the length. Some are motile, others not; many possess bright spores, others show a more or less beaded arrangement, consequent upon local collections of protoplasm within the sheath. They can be cultivated in blood serum and solutions of meat-extract.

Inoculation experiments, so far, upon monkeys and domestic animals have failed; but that the bacilli and spores are the cause of leprous growths is shown by the absolute constancy with which the bacilli are found, and the immense numbers which are nearly always present—a fact verified by the examination of material from Norway, Spain, East Indies, Roumania, Palestine, China, and Australia.

It may also be shown that the presence of the bacillus

will cause the typical development of a migratory cell into that of the so-called lepra-cell as described by Virchow. They are introduced into the body either as bacilli or as spores, and remain for a time quiescent; these are probably deposited in the lymphatic glands, the invasion of the system subsequently occurring, the skin, the peripheral nerves, the testicles, spleen, cornea, cartilage, and liver being infected.

Erysipelas.—The contagious character of this disease was for some time overlooked; and, after its recognition in this country, this character was still denied by observers in Germany and France. Numerous observers have discovered bacteria and micrococci in connection with this disease; but, in order to establish the parasitic nature of a disease, it is not enough to demonstrate the presence of bacteria in the organism, nor even to find them in every case of the disease, but there must be proved a specific and morphologically distinct micro-organism. It is to the researches of Fehleisen that we are indebted for our exact knowledge on the subject of the etiology of this disease. He examined some thirteen cases: from eleven of these he excised small pieces of skin, and found the lymph-vessels—both of the skin, especially the superficial layers of the corium, and of the subcutaneous cellular tissue—to be filled with micrococci, particularly in the form of streptococci. They were also found in the lymph-spaces and channels of the skin, but not in the blood vessels. In this latter respect the observations of Fehleisen are opposed to those of other observers, such as Lukomsky, Billroth, etc. In the zone near the sharp edge of the erysipelatous patch the inflammatory changes appear; the tissue of the cutis is swollen; the lymph-vessels are filled with micrococci, and along their course is found a more or less extensive small celled infiltration. In the older parts of the affected skin the micrococci are wanting, the small celled infiltration being alone present.

Cultivations were made from small pieces of skin cut out with heated scissors from a surface which had been thoroughly well cleansed. These were placed on nutrient jellies of various kinds and on blood-serum; the best results were, however, obtained by placing the bits of skin in the jelly which was liquefied at 40° C. In this way they were brought in better contact with the nourishing medium. After being kept for some little time at this temperature, the gelatine was allowed to solidify, and a temperature of 20° C. subsequently maintained. In two days a number of

small white points appear, which grow slowly until the sixth or seventh day, when they come to a standstill, forming a delicate white layer. The organism grows better at the body temperature on coagulated blood-serum, and continues for a longer time.

Inoculation experiments were made with rabbits. Nine of these animals were taken. One of them did not take, the neighbourhood at the site of inoculation being only slightly reddened; the other eight animals developed typical erysipelas. Six of these were inoculated at the tip of the left ear in four different places. Within forty-eight hours the temperature rose, and a sharply defined redness spread from the point of inoculation, mainly in the direction of the veins to the root of the ear. On holding the ear to the sunlight, the affected zone was seen to be of a brilliant red colour, the vessels being distinctly visible owing to dilatation. In two or three days the process reached the root of the ear, and as the ear resumed its ordinary character, the redness spread to the head and neck.

Another rabbit was inoculated on both ears; on each side erysipelas set in, spreading to the back of the neck, and there meeting.

In the eighth case, after inoculation, and the spread of the erysipelas to the middle of the ear, the ear was amputated, and in twelve hours the temperature became normal, and the animal remained perfectly well. On examination of the amputated ear, the lymph-vessels were found filled with micrococci, and the appearances generally coincided exactly with those found in man.

The duration of the erysipelas, with the exception of the last case, was in all the rabbits from six to ten days, and in no case did the animal die.

Human beings were subsequently inoculated with the organism, the inoculations being undertaken with the view of obtaining certain therapeutical advantages—lupus, epithelioma, keloid, carcinoma of the mamma, and lymphatic gland enlargements of various kinds having been partially or entirely absorbed as a result of an attack of erysipelas.

Fehleisen selected cases of nodules in the gluteal region, cancer of the breast, sarcoma of the orbit, and lupus, in all seven cases, and in six erysipelas was induced, in some cases with benefit; in all there was initial shivering, the characteristic redness spreading on the surface, fever, and lastly, resolution without any suppuration.

It is interesting to note that the spread of these micrococci takes place exclusively along the lymphatics; in no case in

true erysipelas has Fehleisen found them in the blood-vessels; the development of the micrococci also takes place primarily in the lymph-vessels, and spreads by active growth in all directions. It is to be distinguished from the organism present in suppuration processes by the clinical fact that suppuration never supervenes upon the inoculation of the true erysipelas micrococcus; whilst, on the other hand, phlegmon can with certainty be produced by inoculation with the other.

In the seventh patient who was inoculated, erysipelas did not supervene, and it was found he had suffered from frequent attacks of erysipelas previously, his last attack being one of the face, only two or three months before; it was proved by experiments on the other cases that an attack of erysipelas will confer a short period of immunity. The same observer found that a 3 per cent. solution of carbolic acid, or a 1 per cent. solution of corrosive sublimate, destroys the vitality of the micrococcus.

Suppuration and Septic Diseases.—Professor Koch has described in a paper, translated by Mr. Cheyne, in the New Sydenham Society's *Transactions*, a number of diseases in animals, which have, in some respects, a great likeness to the surgical infective diseases of man; these diseases were shown to run a definite course, and their specific nature was demonstrated by the reproduction of their prominent symptoms by the inoculation of a specific microbe found in connection with the disease. In this way we have become acquainted with a septicæmia in mice, a progressive abscess formation in rabbits, a pyæmia in rabbits, etc. From such investigations the inference was correctly drawn that it could only be a question of time before the surgical infective diseases of man were more thoroughly studied and their etiology more perfectly known.

Professor Ogston of Aberdeen was the first to demonstrate the constant presence of micrococci in acute abscesses; he pointed out that in some cases these organisms occurred as streptococci, in others as staphylococci, and these he described as distinct organisms. Rosenbach also recognised these two forms, but came to no definite conclusion regarding them; he made a number of cultivations from the pus of thirty unopened acute abscesses, and isolated five different kinds of microbes; one of these, a bacterium, which was twice as long as it was broad, and which quickly liquefied gelatine, he has never since found in unopened abscesses. A little of this cultivation injected into the eye of the rabbit was quickly followed by sub-acute suppuration without any marked constitutional affection.

The organism most frequently found by him was a micrococcus, occurring in large groups, according to Ogston, in masses resembling a fish-roe or bunch of grapes; these groups appear, however, to consist of two kinds, distinguishable by producing different colours when cultivated, the one producing golden yellow opaque colonies, the other white opaque masses; this difference in colour is always present, whether cultivation be made on agar-agar, potatoes, blood-serum, egg albumen, etc.; they agree, however, in their mode of growth, their microscopic character, and their effect on animals, and have been designated staphylococcus aureus and staphylococcus albus.

The other two organisms are described by him as micrococcus pyogenes tenuis and streptococcus pyogenes.

It will be, perhaps, well to say a few words in reference to each of these.

1. Staphylococcus pyogenes aureus. Cultivations of this organism show in twenty-four hours distinct evidence of growth, first of a whitish-yellow, and then of an orange-yellow colour. The growth increases in width, forming roundish masses. It grows more slowly in the cold, and rapidly liquefies gelatine, the growth then falling to the bottom, and becoming of a dark orange colour. It also grows well on blood-serum and potatoes. When exposed to the air, the growth shrivels up and loses colour, and becomes more difficult to inoculate. Excluded from the air, it retains its vitality for a long time. Microscopically, it is a very small coccus. Injection of this organism into the knee or pleural cavity of rabbits or dogs is most deleterious. Rabbits so treated are generally found dead in the morning, and, if they survive, a severe inflammation follows. When injected into the knees of dogs, the animal survives, but an abscess quickly follows.

2. Staphylococcus pyogenes albus. This grows in luxuriant opaque white masses. Microscopically, and in its effects on animals, this organism cannot be distinguished from the preceding one.

3. Micrococcus pyogenes tenuis. This microbe is only occasionally found; the colonies produced by it are so delicate as to be scarcely visible. On agar-agar around the growths these deposits are formed almost as transparent as glass. Microscopically, the cocci are irregular in size.

4. Streptococcus pyogenes. There are two forms of streptococci in connection with traumatic infective diseases: one I have already indicated as being the cause of erysipelas; the other is the one under consideration. Microscopically,

no characteristic distinction exists between these two kinds of cocci, or between these and another, which I shall presently refer to as being connected with puerperal fever; but culturally, and in their effects upon animals, marked differences are observable.

Cultivations on gelatine of the streptococcus pyogenes forms at first slightly whitish or somewhat translucent round dots, which grow sparingly at 20° C. At a higher temperature, on agar-agar, the growth is more rapid, but still the dotted character is preserved. As the culture becomes older, the growth goes on more in the centre, and assumes a slight brownish colour; the outer border has often a wavy, dotted character, produced by the formation of heaps of cocci. It also grows well on blood-serum, and does not liquefy gelatine.

The streptococcus erysipelatosus has often the tendency to form flat rings, the borders of which are thicker and more irregular; the colonies are also whiter and more opaque than in the case of streptococcus pyogenes; there is also a marked formation of processes, giving the culture the character of a fern-leaf. In the depth of gelatine the growth is somewhat more marked also. The most striking difference, however, is in the effects produced upon animals.

Injections of cultivations cause the formation of abscesses or a local inflammatory nodule; but rabbits are not seriously affected by the streptococcus pyogenes. Mice appear to be more sensitive. Rosenbach noted that two out of six mice inoculated died of progressive suppuration on the third or fourth day after inoculation.

These organisms were either found alone or together by Rosenbach; *e.g.*, staphylococcus alone, 16 times; streptococcus alone, 15 times; staphylococcus and streptococcus together, 5 times; micrococcus pyogenes tenuis, 3 times.

The staphylococcus pyogenes aureus was found alone in a case of empyema of a child, and in a case of perinephritic abscess; whilst a pure cultivation of staphylococcus albus was obtained from a case of spontaneous suppuration of the knee joint. They were found together in a case of large abscess of the abdomen.

Rosenbach had the opportunity of examining six cases of pyæmia. The streptococcus was found five times, partly in the blood, and partly in the metastatic deposits during life; twice combined with staphylococcus pyogenes aureus, but in larger numbers. All these cases were fatal; in one, which recovered, staphylococcus aureus was alone found.

Pyæmia may be divided into two classes or groups; the

first consisting of those cases which occur in connection with larger or smaller local affections, but always of great size, such as a suppurating knee-joint, a large, suppurating, contused wound of the soft parts, a suppurating compound fracture, and the like. In these cases the general symptoms are maintained by local deposits, which continuously supply the body with morbid materials, giving rise to the condition described by Ogston as micrococcus poisoning.

The second group consists of cases in which nothing worthy of the name of a local centre exists. The infective material enters through a small puncture or scratch, the general pyæmic affection following a single, often transitory, infection. Rosenbach believes the streptococcus pyogenes to be the cause of pyæmia.

There is an affection resembling erysipelas which is apt to attack butchers, leather-dressers, etc. From a small wound, generally on the finger, a reddish infiltration extends, spreading with a sharp margin, and coming to an end in one or two weeks, over the metacarpus. There is no fever associated with it. A micrococcus was obtained from the part in the same manner as Fehleisen obtained his micrococcus, which grows on agar-agar as beautiful delicate colonies. Inoculations made with them cause a little brown circle, with itching and burning, which slightly increases in size, and then fades away.

With a view of accurately determining the etiology of such acute purulent inflammations as osteomyelitis, whitlow, etc., Garré made a series of inoculations upon himself, into a small wound reaching as deep as the corium made on the outer border of the root of the nail of the left little finger; he placed, by means of a platinum needle, a small quantity of a pure cultivation of staphylococcus pyogenes aureus, obtained from the blood of a patient suffering from acute osteomyelitis; a slight inflammatory redness appeared for a few hours and then disappeared. He then inoculated three small wounds in a corresponding part on the ring finger of the left hand, with the result that pain, inflammation, and suppuration supervened, and from the pus cultivations of the staphylococcus aureus were obtained. He further rubbed over the skin of the left forearm some of the same cultivation; pain, heat, redness, and swelling followed, with numerous pustules, and in four days an enormous carbuncle appeared, which reached its height on the sixth or seventh day; on the eighth day, pus pressed out of the depth of the wound was inoculated on agar-agar and gelatine, and the resulting cultivation showed microscopically and macroscopically the

staphylococcus aureus. From these experiments the deduction is made that carbuncle and whitlow are infective diseases, caused by the same coccus as is found in osteomyelitis, viz., the staphylococcus pyogenes aureus.

Gonorrhœa.—The organism which is connected with this disease, the micrococcus gonorrhœæ (gonococcus), was discovered by Neisser in 1879; it is constantly present in the pus, and very frequently in the epithelial cells; the cocci generally occur in pairs or groups, and their opposing surfaces are flattened; they are found at the very commencement of the disease, and diminish in nnmber as the disease becomes chronic. This organism is difficult of cultivation, not growing on gelatine, but slowly growing on blood-serum, forming a thin, greyish-yellow coating. Bunner inoculated a cultivation into the urethra of a healthy woman, with the result of producing acute urethritis.

Puerperal Fever.—An inquiry into the etiology of this disease I undertook at the request of the committee of the Brown Institute, and in a paper read last November at the Royal Medico-Chirurgical Society, I have recorded the result of my observations. I obtained from the heart's blood of a patient, who had died a few hours previously from well-marked puerperal fever, a micrococcus, which was present in large numbers; from another patient, who was an inmate of St. Bartholomew's Hospital, I obtained the same organism from the blood taken from the finger.

This organism, in its microscopical and cultured peculiarities, closely resembled those already described as belonging to the organism described by Fehleisen as the cause of erysipelas and the streptococcus pyogenes; its effect, however, upon animals is most distinctive; mice inoculated with it invariably die in the course of two or three days, and the organism can be recovered from their heart's blood; and the ears of rabbits inoculated with it show a well-marked diffused redness, which shows no disposition to spread, and very shortly disappears.

Glanders.—This disease in man is very rare, and it is only within the last sixty or seventy years that its occurrence has been clearly recognised; there is no evidence to suggest that the disease ever originates in man, but is generally communicated by direct inoculation of virus from a diseased animal.

Researches into the etiology of this disease were undertaken by Dr. Löffler and Prof. Schütz. They first sought for definite forms of bacteria among the specific products of glanders contained in the glanders nodules; sections were

also obtained from a horse which had suffered from glanders of the lungs, liver, spleen, and septum nasi; after treatment by various staining agents these were examined microscopically, and fine rods, about the size of a tubercle-bacillus, were occasionally found.

Cultivations were made from a number of small particles taken from the nodules present in the lungs and spleen of a horse which had suffered from glanders, on the blood-serum of a horse, and in three days numerous transparent droplets were found on the surface, which, upon microscopic examination, were found to consist of bacilli, presenting the same characters as those previously found in the nodules; they are very minute, being about the size of a tubercle bacillus; they are brought out by staining with a concentrated watery solution of methylene blue, and then washing with very dilute acetic acid, the water subsequently being extracted by alcohol and the preparations cleared in cedar-oil.

These cultivations were carried through four generations, and then a small quantity was inoculated on the mucous membrane of the nose, and on both shoulders of an old, but otherwise healthy, horse; in two days the animal exhibited signs of high fever, and in eight days showed all the well-known clinical appearances of glanders. The animal was killed some five or six weeks after inoculation, when, upon examining the body, evidence was forthcoming that the animal had suffered from old glanders, so that the experiment could not be considered as absolutely conclusive; fresh cultivations were, however, made from the glanders material upon sterilised blood-serum, with the result that the same transparent droplets in the course of three days appeared, which were found to contain the same bacilli. The same organism was obtained by cultivation from several other glandered horses.

Rabbits, mice, and guinea-pigs were inoculated with the cultivation. In the rabbits, in some cases, local ulcerations and swelling of the neighbouring glands were found; in others ulcers on the septum nasi and glanders nodules in the lungs.

Inoculation of white-mice gave negative results; but of field-mice the results were satisfactory; at the *post-mortem* examination of these the spleen and liver were found infiltrated with small yellowish-grey nodules, from which the bacilli could be obtained.

In guinea-pigs the results were well marked at the site of the inoculation. An ulcer appears with a very indurated base, which speedily enlarges; other ulcers follow, the neigh-

bouring glands enlarge, and general infection follows; nodules and ulcers appear on the nasal septum, and nodules in the internal organs, followed by nodular growth in the testes, ovaries, and vulva; cultivations from all these organs always produced the same pure cultivations, identical with those previously obtained from the horses.

Two horses were now inoculated, the one with a cultivation which had been carried through eight generations, the other with a cultivation carried through five generations. Both of these animals developed the well-known signs of glanders, and the usual *post-mortem* appearances of the disease were found; one of the animals died from the disease, the other was killed; the organism was recovered in the ordinary way by inoculation of blood-serum with particles of the nodules.

Relapsing Fever.—In the blood of persons suffering from this disease a spirillum—the spirillum Obermeyeri—is found; they disappear from the blood during the non-febrile stages; they form long, wavy, flexible threads of varying length; they are motile, and stain well with methyl violet or Bismarck brown. Dr. Carter succeeded in producing relapsing fever in monkeys by injecting the human blood containing the spirillum; the monkey's blood was found to contain the organism in large numbers. Koch has cultivated it artificially, and found it growing as long spiral threads.

Actinomycosis.—The actinomyces, or ray-fungus, which is the cause of this disease, grows in roundish masses, varying in size from small grains to those as large as a hempseed; they are of a yellowish colour, and have a granular surface; microscopically the lumps are seen to consist of a number of radiating threads, with swollen club-shaped ends, forming a sort of rosette; frequently narrow, thread-like hyphæ are seen forming coils in the central parts, or growing peripherally out of the mass. In cattle the disease most commonly begins in the mouth, by the formation of firm tumours in the jaw, the alveoli of the teeth, and particularly by an enlargement and great induration of the tongue, giving rise to the so called wooden tongue; occasionally similar tumours are found in the skin and lungs.

Dr. Israel was the first to point out a disease in man characterised by metastatic abscesses in various internal organs, due to the presence of a fungus, which was proved to be "actinomyces"; since then a large number of cases have been observed, and one was reported recently at a meeting of the Royal Medico-Chirurgical Society by Dr. Douglas Powell and Professor Crookshank. Dr. Israel states that he

has cultivated the actinomyces on solid ox-serum; in fluid media the growth does not succeed, owing to the swelling up and death of the corpuscles.

Anthrax.—This disease in its various forms has been known for many hundreds of years as affecting both man and animals; but until comparatively recent years the internal form of the disease received but little attention. In 1878 Dr. Russell recorded an outbreak amongst horse-hair workers in Glasgow; and in 1880 Mr. Spear, in his report to the Medical Officer of the Local Government Board, pointed out that the so called woolsorters' disease, so prevalent in Bradford, was nothing more than anthrax. There are two principal varieties of the disease, one presenting a characteristic malignant pustule, the other having no external lesion; these two forms are, however, etiologically identical. A third class is sometimes made, viz., that of malignant œdema; and a fourth variety consists in a small pustule, or slightly inflamed tumour or boil, which does not possess the striking characters of the malignant pustule.

From the report before mentioned, it is gathered that the disease has been known in Bradford since the importation and working of alpaca, but that the cases have been more numerous since the introduction in 1863 of the Van mohair, the fleece of a goat inhabiting the Van district of Asia Minor, as a textile fabric.

From a careful examination of a large number of cases, Mr. Spear shows very clearly that the symptoms of the disease, as it affected the Bradford workers, were those of anthrax; and this view was confirmed by the microscopical examinations and pathological experiments made by Dr. Greenfield, for it was shown that the blood, the pericardial fluid, and various tissues of the body contained an organism having all the characters of the bacillus anthracis; further, that if animals, such as guinea-pigs, be inoculated with these fluids, effects would be produced identical with those produced by inoculation with the blood of animals dying of splenic fever, such effects being death in a brief space of time, and the presence in the blood of the anthrax organism; and, further, that the organs of such inoculated animals, when examined microscopically, showed lesions similar to those seen in animals dying from anthrax inoculation.

Let me quote one or two examples. A man named Greenwood, aged 48, was attacked with the disease. Blood was taken from his arm, which was found to contain a few bacilli, and inoculations were made of guinea-pigs on the inner side of the thigh. These animals died in twenty-nine

hours. An examination of their bodies showed the typical characters of anthrax, and bacilli were recovered from the spleen and heart's blood. Upon the death of this patient, guinea-pigs were inoculated with blood obtained from the heart, with fluid expressed from a bronchial gland, and with serum obtained from the pleura; and in every case the animals died within forty-eight hours. The blood, on examination, was found to contain large quantities of the anthrax organism, and the spleen, which was enlarged, also swarmed with bacilli. Cultivations in aqueous humour, made from the splenic blood of two of these animals, produced typical growths of the bacillus.

Another case was that of a man named Heaton, who died after exhibiting well pronounced symptoms of this disease: Inoculations of animals were made with blood obtained from the spleen, and with fluid obtained from the lungs. In both cases the animals died within forty-eight hours; bacilli were found generally in the body; the spleen was much swollen, and contained numerous masses of bacilli.

An observation upon which Dr. Greenfield laid great stress, as affording evidence of the mode of infection in woolsorters' disease—viz., by the inhalation of the spores adhering to the wool of the fleeces of animals dead of anthrax—was the co-existence of mediastinal cellulitis, an engorged or hæmorrhagic condition of the bronchial glands, great serous effusion into the pleuræ, causing collapse of the lungs, and, lastly, the presence of a number of multiple pustules in the bronchi.

From recent observation by Dr. Koch and others, it appears certain that infection by the alimentary canal can be readily produced by spores.

The single bacilli, as they appear in the blood, measure between 0.005 and 0.02 mm. in length, and 0.001 to 0.0012 in thickness, and are truncated. The spores, produced by growing the bacilli with free access of air, are about 0.001 mm. thick, and about 0.002 to 0.003 mm. long. They are not stained by the ordinary dyes. They grow well in any fluid containing proteid material between the temperature of 15° and 43° C., but best between the temperatures of 25° and 40° C. They elongate and divide rapidly, and grow out into long, curved, and twisted filaments, forming bundles. Microscopically they are seen to be composed of a thin hyaline sheath, which contains a row of cubical or rod-shaped masses of protoplasm, which stains readily with aniline dyes. According to the length of the bacilli, the number of these masses of protoplasm varies. Some of the elements appear

constricted in the middle, preparatory to division; the elements are connected by a fine septum. When grown on a solid medium, such as gelatine or agar-agar, some of the elements assume a torula-like form, and, as such, multiply by gemmation and division, and form clusters, or arrange themselves in chains.

The anthrax-bacillus liquefies gelatine. When grown in the depth of a fluid, the bacillus does not form spores; but, grown on the surface, with free access of air, the bacilli having developed into filaments, proceed to form spores. Spore formation occurs at all temperatures, from 18° to 45° C., and this consists in the appearance of bright, glistening, spherical bodies in the protoplasm of an elementary cell. This body enlarges, and ultimately becomes of an oval shape. Under the most favourable conditions, each cubical or rod-shaped mass of protoplasm includes one spore, in which case the filament would contain an almost unbroken row of spores. In a dry state these spores stand heating to 100° C. for over an hour without being killed; but in the moist state, at exposure to steam at 100° C., they are killed in fifteen minutes. Many interesting and important experiments have been made with this organism by Pasteur, Koch, Klein, and others; but these are beyond the scope and intention of this sketch.

There are other diseases with which micro-organisms have been found connected, such as cholera, scarlet fever, diphtheria, pneumonia, syphilis, enteric fever, etc.; but these I refrain from considering, partly because the connection has not been generally admitted, and partly because, in the case of one of them—scarlet fever—it has but very recently been brought under the notice of this Society by my friend, Professor Klein.

I am indebted to the writings of Dr. R. Koch, Dr. Fehleisen, Mr. Watson Cheyne, and others for valuable information in the preparation of the foregoing paper.—W. R. S.

ON BERI-BERI.

By W. A. MORRIS, L.R.C.P.Edin., Surg. M.S.

(*Read: April 10th*, 1889.)

Mr. President and Gentlemen,—During the autumn of 1887, when I was in active service in Upper Burma, a severe epidemic of beri-beri broke out in the gaol at Mandalay, and I obtained, through the courtesy of Surgeon-Major Macdonald, the Superintendent, permission to examine these cases. I examined in all 110 cases, of which I have recorded 50, as fully as the means at my disposal would allow. I possessed, at this time, no library, or means of obtaining any additional knowledge of this affection, and, beyond its name, I could not pretend to any acquaintance with its character. I venture to mention this, in order to describe the impressions this disease made upon me, impressions which, more or less, agree with the published essays on beri-beri, but interpret their meaning in rather a different manner.

The origin of the term beri-beri is very old, and is most probably derived from the two Arabic words *bahri*, a sailor, and *bar*, the sea. Richardson, in his Arabic Dictionary, attributes the word to *buhr* (shortness of breath) and *bahri* (marine); *buhr bahri*, marine dyspnœa. Before the age of steamers, and when long passages were undertaken in sailing-boats, beri-beri was by no means an uncommon danger to the crews, and this was especially the case among the ships which navigate the Indian Ocean, Arabian Sea, Bay of Bengal, and Indian Archipelago. It has been suggested that the name was derived from *bhére*, the Hindustani for a sheep, from a supposed likeness of the gait to a sheep's walk. Soond-ki-baie, numbness and rheumatism, is mentioned. The Arabic origin, however, seems to be the most probable, for by simple transposition of the Arabic letters for the English, nearly the exact word is obtained (Morehead).*

In China, beri-beri is known as kiohti, or "malarial leg", and there they recognise two forms, B. hydrops and B. atrophia, and say that one is caused by moist heat, and the other by moist cold. At Tunking it is called the "mauvaise vent",

* In Ceylon, *beri* signifies weakness, and *beri-beri* intensifies the meaning.

and this term is attributed to the Abbé Richard (Gordon). In some parts of China it is called the "slow wind" disease. In Japan, beri-beri is known as kakké, and in Burma as bane-lya coyun (small cracks on a swelled body).

GEOGRAPHICAL DISTRIBUTION.—Beri-beri principally occurs along the coast line, and has been reported not to extend more than 60 miles inland (Maclean); but this latter observation does not appear to be applicable in all cases, for the epidemic I saw occurred 500 miles up country, and at least 100 miles from the coast, the mountains of Aracan intervening, which are ranges of no inconsiderable altitude. Dr. de Scilva Lima reports from Brazil: "In the latter months of 1866 the number of cases of beri-beri became so considerable as to constitute a severe epidemic. It spread all over the province, and hundreds of miles into the interior, as well as over the neighbouring and other provinces of the empire." Beri-beri occurs along the Malabar Coast of India, Northern Ports, Madras, Ceylon (called Ceylon-palsy), Burma, Straits Settlements, China, Japan, West Coast of Africa, Australia, Brazil. The epidemic range of beri-beri is 37° N. to 33° 59″ S., from the Island of Japan to Sydney in Australia (Chevers). The endemic range is only within the limits before noted, the sea-shore, and not more than 60 miles inland.

"The climate of Burma is moderate and equable, and notwithstanding the heavy rainfall, the health of European troops stationed in the province, which was originally very bad, is now better on an average than in India proper" (*Imperial Gazetteer*, 1882). It is a great drawback to Burma proper that there are no mountain sanitaria where Europeans can recruit their health. They were tried, but the jungle growth was so rapid during the rains that they had to be abandoned. Since our occupation of the Upper Province hill-stations have been tried again, but the bill of health from these can, so far, be hardly regarded as satisfactory.

December, January, and February are the cool months; March, April, and May the hot ones, and the driest and most unhealthy. June, July, and August are wet, representing the monsoon; September, October, and November also wet, hot, and damp, and most unhealthy. The rainfall averages 160 inches. Highest temperature I recorded at Mandalay, 105° Fah.; the lowest, 55° Fah. Mean diurnal change, 25° to 14°.

The Irrawaddy, one of the largest water-ways in the world, traverses Burma from the Chinese frontier to the Rangoon river, and of its many branches the Chindwin river is the largest and most important. Cultivation is carried on along

its banks, the staple industry being the growing of paddy-rice. Burma, for the most part, is virgin forest, and essentially a highly malarious country, and possesses all the factors which are necessary for the development of the poison.

All the buildings, from the poorest to the richest, are built on piles of wood, the danger of the malarial poison near the soil being well known. Sanitation, until our occupation, was unknown; a little round hole in the floor of a room being sufficient accommodation for the purposes of nature.

CAUSATION.—The origin of beri-beri has been the subject of many theories by different observers. The chief are those advanced by (1) Ranking, who attributed it to renal anasarca; (2) by Malcomson, who attributed it to paraplegia and scurvy; (3) by Morehead, who looked upon it as the expression of the scorbutic cachexia; (4) by Bankin, who inclined to a nervous origin; (5) by Chevers, who called it an exanthematous fever, best known by its sequelæ, viz., acute general anasarca, and frequently, but not constantly, Bright's disease, and paraplegia; (6) by Dr. Kynsey of Colombo, who attributed beri-beri to a worm in the intestines, called the sclerostoma duodenale; (7) it is attributed to disease of the blood; (8) by many authors to malaria.

Beri-beri as Renal Anasarca.—Quoting from Chevers, who, in turn, draws from the *Proceedings* of the Hyderabad Medical and Physical Society, it appears that Mr. J. L. Ranking published, in 1853, a series of reports tending to show that the previously obscure disease, beri-beri, depended mainly upon the existence of a form of Bright's disease. He thought that the deterioration of the blood is caused by lesion of the kidney, and that the numbness, staggering gait, or more confirmed paralysis of motion, the irritable condition of the heart, the endo, or pericardial inflammation (?), and the effusion—which latter is generally the immediate cause of death—are secondary affections. He showed that in 16 cases of beri-beri the urine was more or less albuminous in 11. He found the urine of a specific gravity above the normal standard, concentrated, and scanty. Dr. Lovell, reporting on the epidemic which occurred in Mauritius in 1878, termed the disease acute anæmic dropsy. He remarks: "The urine was seldom albuminous. In my cases the urine appeared to me the reverse; it was pale and watery, of a specific gravity of 1010-1014; there was no albumen, and no sugar. I saw no symptom or indication of any kidney affection, which, in Eastern races is comparatively rare. The nervous symptoms, which were so marked in the epidemic at Mandalay, are not in any way characteristic of Bright's disease."

I would mention the reported symptom of the suppression of the urine. In the Singapore outbreak, which commenced in 1875, it is stated that fatal cases are preceded by almost complete suppression of the urine, and Sir William Aitken writes, "As the disease progresses, a total suppression of the urine generally takes place." This is not in accord with my experience, but I have noticed retention of the urine from muscular inability to void it, and the fact of the patients pressing on the fundus of the bladder from the outside to assist in its expulsion, was a common clinical observation.

Beri-beri as an Expression of the Scorbutic Cachexia.—Scurvy has been noted by some Indian observers as the cause of beri-beri. In the goal at Mandalay frequent examinations of the prisoners were made to endeavour to find out whether the epidemic was in any way caused by this condition.* Dr. Lima, writing in reference to this disease in Brazil, states: "The acceptation of the scorbutic diathesis as being the cause of beri-beri is inadmissible. It attacked all classes of society, the healthy and well-fed equally with the poor, and nothing can be more opposite than the two diseases under treatment."

The system and arrangements of H.M. Indian gaol were so complete, that I think if scurvy had any part in causing this disease it would have been prominently brought to notice. The diet of the prisoners was: Rice, 1 lb. 8 oz.; vegetables, 10 oz.; meat, 4 oz. (or, in lieu, the same quantity of dal and fish); salt, ½ oz.; oil, ½ oz.; condiments, ½ oz. The beri-beri patients were given, as an extra preventive measure, and in case scurvy might be the cause: Plaintains, 4; limes, 1; chutney (jogri, tamarind), 8 drs.

Scurvy is an uncommon affection in Burma, the facilities for obtaining antiscorbutic food being very great through the whole year. It is quite reasonable to expect that individuals with the scorbutic taint would be more predisposed to beri-beri, when exposed to its effects, as they are to many other affections.

When beri-beri was first observed, it was principally in connection with the crews of ships sailing in Indian waters, and it became intimately associated with scurvy; hence the origin of the supposed cause, which I cannot but regard as erroneous.

Dr. Kynsey's Views.—The *sclerostoma duodenale* was not found in any of the cases where a *post mortem* examination took place, and there was no sign in the epidemic to lead me

* Two prisoners out of about 600 men had "spongy gums", and they were both recent arrivals.

to suppose that such a cause existed. Surgeon Gimlette, in his report from Singapore, corroborates this statement.

Surgeon W. F. Thomas, in the *Indian Medical Gazette*, April 1889, states that the proximate cause of beri-beri was the presence of *anchylostomum duodenale* in a very large proportion of his cases. Out of 177 cases examined, 128 were under thirty-five years of age, and 152 males. He finds that debility following ague, renal disease, and scorbutic cachexia favour its occurrence. It is common in jungle-districts after the rains. In fact, Dr. Thomas proves the malarial origin of beri-beri, at the same time attributing the majority of his cases to this parasite, instead of considering them as an accidental accompaniment, which they most probably were.

Beri-beri considered in reference to its Nervous Origin.—Surgeon Bankier, of the Royal Navy, appears to have been among the first to have suspected a nervous origin of beri-beri, and in his essay on it, in 1835, he says: "Let us hear no more ranting or cajolling about the invisible nature of the actions of the nerves, but admit them at once as being those agents on which the production and operation of certain diseases depend." He suggested a similarity between cholera and beri-beri in the causation, the symptoms, and the pathological results. He further adds: "I look upon beri-beri as depending on a particular disposition, somehow or other induced in the system by agents of a powerful nature, these, in all probability, identical with those of epidemic cholera."

It is more than likely that if a micro-organism should be discovered in beri-beri it will be found to be quite distinct from that of cholera. The first and principal symptom of beri-beri being anasarca, and dropsical effusion into areolar tissue and serous cavities, the occurrence of spinal paralysis, as one of its complications, can then be accounted for. The nervous symptoms may, in fact, result from the fluid pressure on the spinal cord, *i.e.*, from the anasarca, and therefore not be in any way the origin of the disease.

Acute Beri-beri an Exanthematous Fever characterised by general Dropsy, Effusion into the Serous Sacs, and other grave Sequelæ.—This is the opinion to which Dr. Norman Chevers gives special prominence, and I am unable, from my experience, to deny this; but I saw no indication, in any of my cases, to lead me to suspect such a cause. There was no elevation of temperature above the normal recorded of any case, but, on the contrary, the majority of temperatures were subnormal, indicating the condition of extreme exhaus-

tion. All my cases were developed in the gaol, under daily inspection, and any previous symptoms of exanthematous fever would have been observed.

Is the Condition Beri-beri a Peripheral Neuritis?—I am not altogether disposed to adopt this theory as a satisfactory solution of the question. There are many points clinically which are similar; for instance, in both the onset is more or less sudden, followed by numbness and tingling, loss of tactile sensibility, to which succeeds loss of motor power, from the slightest paresis to complete akinesis. The attack of beri-beri is often symmetrical, but not always so. The general anasarca of beri-beri is a constant symptom of the disease; but in peripheral neuritis it is absent. Many of the symptoms might be explained by a neuritis of the affected parts, but rather spreading from the cord than peripheral.

Is Beri-beri due to an Affection of the Blood?—Sir Joseph Fayrer has suggested the probability that filarious disease may be in some way concerned in inducing beri-beri. A form of spinal paralysis in the horse, called "kumri", was very prevalent in Burma at this time among the horses of the Bengal Cavalry. Another disease of the horse, called "surra", and recognised by acute wasting and fever, occurred at this time, and was very fatal. "Kumri" has been ascribed to an entozoon in the cord; but "surra" appears to be a disease of the blood, in which rods are found. Sir Joseph Fayrer's note is very suggestive, and I regret I had not the means to follow up a minute examination of the blood; but, as far as my observations went, marked changes were apparent in the blood in beri-beri, consisting chiefly in a watery condition, and a diminution of red corpuscles, such as occur in the anæmia resulting from malaria. It is very striking that under the same condition of living, climate, etc., in which beri-beri occurred in man, "kumri" and "surra" were prevalent among the horses.

Surgeon J. F. Evans, of the Bengal Medical Service, was good enough to examine some of the blood from my beri-beri patients for me. He states the red corpuscles of the blood were found diminished in number, and crenated, the blood was watery, and brilliant free bodies were to be seen in the field. Dr. Evans, in the *British Medical Journal* of April 28th, 1888, writes, in reference to the blood in the malarial state, and its relation to beri-beri:

"Softening and crenation of the red corpuscles is a marked feature; in such cases, it is difficult to find in a specimen of blood a corpuscle with normal outline. It is due probably to a gradual loss of the cell-contents, and may serve to

account for the intense anæmia that occurs in malarial cachexia. The red corpuscles are not only altered in structure by this disease, but are absolutely destroyed in the process; they can be seen in every stage of destruction, from mere erosion of the margin to almost complete obliteration, a thin semilunar rim of pellicle being left."

"In addition to the structural changes already mentioned in the blood-corpuscles, I have found free spherical bodies in the serum, and in the corpuscles. These spherical bodies are possessed of movement, both rotatory and from place to place. They are of two perfectly distinct kinds, and I shall, for the purposes of description, describe them as nucleated and non-nucleated, although not considering the nuclear body of the nature of a nucleus."

He goes on to say: "I have found the (non-nucleated) spherical bodies in the serum and red cells of the blood of men suffering from beri-beri; and also in the serum and red cells of the blood of horses suffering from 'surra', in company with Surgeon Hendley, who tells me he has observed similar bodies in the blood of rats, and of a dog ailing with fever."

Dr. Evans further reports: "I have not seen the nucleated bodies in the blood of beri-beri where the non-nucleated occur, in which disease, on two occasions quite recently, I have found a streptococcus, in chains of three cocci each, not very unlike the cocci occurring in 'kumri'."

Beri-beri an expression of Malaria.—That the malarial poison was the origin of the epidemic I examined, I have but very little doubt. The subjects of the disease had been living hard and irregularly, undergoing much fatigue and privation during that period of the year which is most unhealthy, and in which sickness, the results of malarial poisoning, are most evident. The effect of malarial poisoning in the first instance is to cause anæmia, and this becomes most intense if the fever is prolonged. The result of the anæmia is to affect the nutrition of the nerve-centres of the vaso-motor system, thus explaining the train of symptoms which follow. The anæmia thus induced affects the nutrition of the vaso-motor system, and allows the watery blood to exude from the "toneless" vessels. The consequent anasarca in the limbs, at first most marked from the effect of gravity, rapidly spreads upward, while at the same time the serous cavities fill. The effusion into the arachnoid would explain the subsequent impairment of function of the spinal nerves, here, again, commencing below. In this way, the whole train of symptoms follow from the anæmia of malarial poison.

AGE.—From an examination of my cases, the following is the result:—

10	years to	20	years	.	1
20	„	30	„	.	23
30	„	40	„	.	10
40	„	50	„	.	6
50	„	60	„	.	7
60	„	70	„	.	2
70	„	80	„	.	1

The third decade of life includes nearly 50 per cent. of those attacked, the predisposition to the disease gradually decreasing towards old age. It also represents the period at which the largest amount of physical work is done, and the greatest exposure incurred; in fact, it is the time of life when the system is most exposed to disease, and liable to suffer from all debilitating causes. Nearly all the men in my list were prisoners undergoing a sentence for dacoity. A dacoit is a robber, and, when on any of his predatory excursions, lives extremely hard and irregularly. Among the Burmese dacoity is part of their life. No woman of any spirit would marry a man who has not achieved some notoriety as a dacoit, in proper keeping with his station in life. Burmese notables collect a body of these freebooters, and for months will raid a district, thus exposing their following to the hardest living and all the vicissitudes of weather and climate. It is from the rank and file of these that most of my cases were derived, men averaging between 20 and 30 years, the irresponsible decade of human life.

SEX.—Beri-beri does not appear to attack women often. I never saw a case, and, as the result of frequent inquiries among my patients, one man only had heard of a case. Surgeon-General Gordon remarks, in reference to China: "Comparatively few women suffer from it, except during pregnancy, and for a short time after confinement; its most common form in these is the wet." Dr. Gordon's views are confirmed by Dr. Lima, who records a case. This is a very interesting statement, because women during these times enjoy an unusual immunity, as a rule, from acute diseases, though we may note the prevalence of anæmia under these conditions.

RACE.—All races are liable to this disease, but foreigners are not commonly attacked until they have lived a few months in the country. Among the natives of India, Mussulmans suffer more than Hindoos. Beri-beri is now comparatively rare in British India, having been banished, with

other scourges, by the sanitary measures initiated, organised, and carried out by the officers of H.M. Indian Medical Services. It is still, however, by no means uncommon on the confines of our territory.

SYMPTOMS.—Beri-beri has been divided into acute and chronic, dry and wet, and various other divisions. In this epidemic most of the cases were acute, and consisted of three marked stages, in addition to the preliminary, these being constant in every case, though varying in intensity and degree. The stages are:

1. Stage of œdema and numbness.
2. Stage of passive congestion and general anasarca.
3. Stage of paralysis and atrophy.

The earliest symptom in the preliminary stage is anæmia, and it remains in a marked and an intense form throughout the disease. Nearer the advent of the declared disease, stretching pains in the limbs and loins occur, and a girdle-pain is not infrequent.

First Stage of Œdema and Numbness.—After an attack of fever, or after exposure, œdema attacks both feet, and following this numbness, stiffness, and tingling of the swollen part occurs. The œdema increases more or less gradually. Accompanying the œdema is sensory paralysis, both superficial and deep, the patient not feeling a needle thrust deeply into the part, or severe pinching of the skin. Within a short period of the onset of the symptoms there is a feeling of weight and oppression in the epigastrium, at a point exactly below the ensiform cartilage. This is a constant symptom, and in my notes I call it *hyposternal pain*. It is due to the commencing pericardial effusion. The patient suffers from drowsiness and tendency to sleep. The condition gradually becomes worse and the symptoms more intensified, and the second stage is entered. Effusion takes place into the cellular tissues and serous cavities, the numbness and tingling increase, dyspnœa becomes urgent, and the hyposternal pain most acute. The patient cannot lie down unless the head is raised, and the condition becomes, from intense anxiety and fear of impending death, most critical. This stage may last from two or three hours to as many days, when, if the patient survive, the effusion is gradually but very slowly reabsorbed, and the third stage commences. Motor paralysis attacks the feet and limbs in precisely the same order as the œdema in the first stage, and is accompanied by atrophy and intense debility.

The gait of the patient is peculiar and characteristic. At the end of the second stage and the early part of the third

stage, if the patient is able to move about, it will be noticed that he walks with the limbs stiff and straight, much resembling a pair of compasses when made to walk across the table; later, the motor power becomes slowly lost, the individual only being able to fix the leg by throwing the weight of the body upon it. He staggers, with the body bent, and each leg, as it is raised and advanced, has the foot drawn inwards; later, all power is lost in the legs, and the patient sinks down, and can only move by sliding on his ischial tuberosities with the aid of his arms; when these are affected he lies powerless. Accompanying the paralysis are acute atrophy and emaciation, both very extreme. The third stage ends in exhaustion, or recovery partially takes place, leaving the patient a chronic paralytic; and a few cases completely recover.

The heart in beri-beri is always in an irritable state, and it is in connection with this organ that the greatest danger is to be apprehended in the second stage. The symptoms are those due to pericardial effusion. In the last stage the oppression is less, but the cardiac irritability remains. The chest is œdematous, and there is pleural effusion. The respiration is thoracic and puerile, the extraordinary muscles of respiration being brought into play. In the second stage the dyspnœa becomes very urgent, the breath-sounds become bronchial in character, and breathing is relieved from time to time by a long, deep sigh. Hyposternal pain is an early and constant symptom until the disease has advanced well into the third stage. The alimentary tract suffers, there is anorexia and vomiting. Vomiting is a regular symptom. The motions are clayey, and often loose in character. The urine is pale and watery, of a specific gravity from 1008-1014, slightly acid, and transparent; there is no sugar, and no albumen. The amount passed was normal.

Duration.—Acute beri-beri may run its course in six hours; that is the most rapid case that has occurred in my personal experience; and any case running its course in three or four days to a week I should term acute. Chronic beri-beri is a matter of months, and longer.

Terminations.—Beri-beri is an exceedingly fatal disease, especially towards the end of the second stage, when death takes place from syncope, the result of pressure from the effusion. As in cholera, so in beri-beri, the severity of an epidemic varies, some yielding a very great mortality, others less. Professor Aitken gives the ratio of deaths to admissions—in Europeans, 26 per cent.; in natives, 14 per cent. If the patient survive the second stage, his affection may terminate in one

of three ways—(*a*) recovery; (*b*) chronic paralysis; (*c*) exhaustion, inanition, and death.

(*a*) *Recovery.*—Complete recovery occurs occasionally. One attack of beri-beri does not prevent a second.

(*b*) *Chronic Paralysis.*—A large number of individuals who are attacked by this disease become chronic paralytics, and are to be found sitting with the beggars in the gates of Eastern cities.

(*c*) *Exhaustion.*—A very common termination, very gradual, and protracted in its course. The condition of the patients towards the latter end of this stage is very remarkable. I have never seen debility and emaciation so pronounced; and, unless I had seen it, I could scarcely believe such to be compatible with life.

I regret I am unable to give accurately all the terminations of my cases; but, in order to avoid further development of the disease, all my patients were transferred, for change of air, to Lower Burma.

Post-mortem Appearances.—On a case in the second stage the external appearances were general dropsy and anasarca; face purple; lips livid; hands clenched; a tumour, the size of a walnut to an egg, apparent below sternum, and evidently pericardial; blood fluid. On section there was serous oozing from all the tissues. On opening the chest the pleural cavities were found to be more than half full of serous fluid; the lungs were œdematous. On cutting into the pericardium the fluid gushed out. Tissue of heart was flabby; liver normal; kidneys slightly congested; spleen enlarged. In peritoneal sac there was fluid. Upon extracting the spinal cord, this organ appeared normal, except in the lumbar region, where some flocculent adhesive matter was deposited. There was fluid in the arachnoid. No entozoa noticed.

Remarks.—I would classify beri-beri only into acute and chronic, each case consisting of three marked stages, viz.—(1) œdema and numbness; (2) passive congestion and general anasarca; (3) paralysis and atrophy. The division into *beri-beri hydrops* and *beri-beri atrophia* I am not disposed to accept, but rather look upon these terms as applying to two of these stages. The three stages, I remark, may all be very apparent, or one may develop more than another; a severe second stage is very fatal; the third stage is of longer duration, and in its worst form also very fatal.

As regards the theories which have been advanced as to the causation of beri-beri, I think the absence of albumen in the urine, and of other signs of renal disease, would exclude

the theory of renal anasarca. The constant supervision of the prisoners, from whom my cases were drawn, precludes the possibility of exanthematous fever, which in this outbreak could not have escaped notice. Scurvy, when present, has been shown to be an accompaniment, more than a cause, of beri-beri. Three theories remain—the *neurotic*, the *hæmic*, and the *malarial*, and each appears to contain the elements of truth, though singly none of these entirely explain the symptoms. The neurotic theory explains many of the manifestations, but does not show how the spinal cord became affected in the first instance. A morbid condition of the blood most certainly exists. From the evidence, I think the malarial theory is correct. The malarial poison, by producing the profound anæmia, which seems to be the *immediate* cause, *is* thus the origin and remote cause.

TREATMENT was mainly directed to improving the blood and lessening the effects of pressure. For the latter, diuretics were largely used; for the former, iron was given internally. A mixture of many articles is given by the natives, and known as "Treak Farook", or "Theriaca Andromachi".

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Troches squills	6 ounces
Troches of vipers, and long pepper and opium	āā 3 ounces
Red roses, Florentine orrice, juice of liquorice, navus seed, balsam of indaen, agaric	āā 1½ ounce
Powdered myrrh, Arabian cistus, cassia wood, Indian spikenard, flowers of camel's hay, olibanum, white and black pepper, ditany of Crete, tops of white horehound, fine rhubarb, Arabian staechas, Macedonian parsley-seed, mountain calamint, turpentine of Clio, sanque foil, ginger	6 drachms
Poly mountain, ground pine, storax in tear, spikenel, amomum, valerian, Celtic spikenard, sealed earth, Indian leaf, gentian, aniseed, balsam, gum arabic, cardamoms, flowers St. John's wort.	

All mixed with Spanish wine, to give proper consistence.

ABSTRACT OF PAPER ON BERI-BERI BY STAFF-SURGEON T. D. GIMLETTE, R.N.

By H. TURNBULL, M.D., Fleet-Surgeon R.N.

(*Read: April 10th.* 1889.)

Beri-beri is very common in Singapore and the Straits Settlements, where Dr. Gimlette was recently stationed, and at the local hospitals he had opportunities of observing the disease. The disease presents many features about which the greatest diversity of opinion exists. Dr. W. R. Kynsey of Colombo, in 1887, published a report, in which he maintained that the question of the cause of beri-beri was settled, and it was due to the presence of parasites—*Anchylostoma Duodenale.*

The beri-beri of the Straits Settlements would appear to be an essentially different disease.

The beri-beri of Ceylon, as described by Dr. Kynsey, is characterised by anæmia, with a tendency to death from syncope or embolism, and is due to the presence of the intestinal parasite already named, as established by the researches of Dr. Adolph Tutz, a Swiss physician.

The mortality among the Dutch European soldiers in Java has been excessive.

The disease is prevalent in Ceylon and India, and among the Tamils or coolies from the Malabar and Coromandel coast, who, it is thought, probably introduced it into the Mauritius, the Antilles, Guiana, and Brazil. Egyptian chlorosis is identical with it, as also the miner's anæmia seen among the workers in the Mont Cenis Tunnel. Tropical debility, malaria, exposure, and privation predispose to it, as do overcrowding and faulty hygienic conditions. Telluric conditions influence it, and it is remarkable that, as in malaria, the areas where it prevails are often narrowly circumscribed, while the adjoining districts, with identical climatic conditions, are not infected. A diet deficient in nitrogenous elements would appear to predispose to it, and also impure drinking-water.

The essential cause, however, Dr. Kynsey maintains, is the presence of the anchylostoma or sclerostoma duodenale

in the duodenum and jejunum, as first demonstrated by Dr. Tutz in 1885.

Dr. Erni of Sumatra, in 1886, reported that in fifty *post mortems* of beri-beri he never failed to find this parasite, whilst he failed to find it in the dead from other causes, or if present, it had not produced the lesions seen in beri-beri cases; he termed the disease helminthiasis, while Tutz had called it anchylostomiasis.

The symptoms of the disease are characterised in the early stage by dyspepsia, hypochondriac pain, nausea and vomiting —the latter a very constant symptom—and occasionally ova of the parasite are expelled.

Geophagy is common in Ceylon among the coolies. Disorders of the circulation succeed—palpitation with dyspnœa on exertion, and cardiac pain, with subsequent hypertrophy, and quickened and intermittent pulse. Anæmia is now a marked symptom, the red corpuscles of the blood falling to a fourth or sixth of the normal numbers. Dropsy follows, also facial œdema, ascites, etc.; paresis in the later stages; and the urine is, as a rule, normal. Death arises from œdema of lungs, syncope, or embolism.

An acute and a chronic form of the disease is recognised, some cases proving rapidly fatal, while others linger on for many years.

Complications.—Intestinal hæmorrhage most common; chronic gastric catarrh very common also; hydrothorax, hydropericardium, and œdema of lungs, cerebral embolism, tuberculosis, epistaxis, hæmatemesis, etc.

Diagnosis is assisted by the absence of febrile attacks; there is no splenic hypertrophy, and the ready discovery of the ova of the parasite in the stools is very diagnostic.

Pathological Lesions.—Primarily in the intestines; submucous hæmorrhages, dependent on the presence of the parasite itself.

The anchylostoma duodenale is a nematoid worm, non-segmented; 6 to 15 mm. is the length of the female, 6 to 8 mm. that of the male. They are more slender than young ascarides, less white and thicker than the oxyuris vermicularis; the head bent towards the dorsal aspect is diagnostic. The ova expelled develop in damp earth or water into a larval form, which becomes encapsuled, the capsule becoming calcified; it is supposed to enter the human alimentary canal in the larval form, encystation taking place beneath the mucous membrane, whence it escapes in the mature form, and commences its active career of blood-sucking or drawing.

Treatment.—The most effective remedies are the oil of

male fern and thymol to remove the parasite; iron and nutritious diet to combat the dropsy and debility.

Preventive measures consist of (1) removal from the infected locality; (2) pure drinking-water; (3) good food; (4) good sanitary arrangements.

The Beri-beri of the Straits Settlements, China, and Japan.—The disease, as seen here, is characterised by a peculiar form of paralysis, attended, in most cases, by slight anasarca, great mental and bodily prostration, and sudden death. It has been known in China and Japan for ages as Kak-ke. In Sumatra it would seem that the Chinese enjoy an immunity where the disease is making great ravages among the Dutch troops who are Europeans.

The disease is considered endemic, with seasons of epidemic activity. Mr. Gimlette, from his personal observations, is inclined to attribute these so-called epidemics to anchylostomiasis not recognised. Telluric conditions are influential as far as the Straits Settlements are concerned, and most cases come from low-lying wet districts, but some from high altitudes. Overcrowding is found to be a predisposing cause, as are all insanitary conditions.

The essential cause is a subject of much disagreement of opinion; four views mainly are taken of it—(1) the specific; (2) the malarious; (3) the dietetic; (4) the parasitic.

Dr. C. A. Pekelharing of Utrecht, from investigations in Acheen, maintains the specific view, and describes the micrococcus which he succeeded in cultivating from cases of beriberi and inoculating into rabbits, most of which became affected with symptoms of paralysis, nerve-degeneration being found, and it was found possible to infect animals by injecting bacteria obtained from the air of a barrack-room where the disease was prevalent; and in these animals the characteristic micrococci and nerve-degenerations were observed (*British Medical Journal*, 26 Nov. 1887). In Penang, Drs. Kerr and Hampshire strongly maintain its contagiousness, or at any rate its communicability from man to man, and produce many instances in favour of this view, which is supported by Drs. Cornellisseen and Sugenoya in Acheen. This view is contested by the Singapore medical men.

(2) The malarious view has been held for some time, but it is doubtful if it be not merely a predisposing cause.

(3) The dietetic view is the one held by the majority of physicians in the Straits Settlements, the idea being that the disease is due to a deficiency in nitrogenous food and an excess of carbonaceous elements—such as a rice diet. Others look on it as a scorbutic affection, though there are many

arguments against this view, chiefly owing to the manifest influence of locality.

(4) The parasitic view. There are not wanting observers in the Straits Settlements who agree with Dr. Kynsey of Colombo; this view is also supported by the presence of the ova of the anchylostoma duodenale, which are to be found in the stools of all beri-beri patients, and the presence of the parasite itself in the intestines on *post-mortem* examination; the parasites are, however, in comparatively small numbers in the cases of beri-beri in the Straits Settlements. Much more investigation is yet necessary to establish this point in one way or the other. Thymol treatment, however, has proved very successful in the Straits Settlements.

Mr. Gimlette considers the evidence is in favour of a specific poison, distinct from all other diseases, and not to an intestinal parasite, considering the prominent symptom of paralysis of the motor nerves.

Symptoms.—Dyspeptic in the first instance, epigastric pain and sometimes vomiting and diarrhœa, but more generally obstinate constipation. No perversion of appetite, no geophagy, as see in anchylostomiasis. Articular pains are among the most frequent premonitory symptoms. The circulatory symptoms are not so noticeable as in the beri-beri of Ceylon, the cardiac palpitation occurring only in 60 per cent.; but the earliest characteristic symptoms are paralysis, beginning with anæsthesia, neither complete nor general, and numbness localised in the feet and calves, also in the finger tips. Pains and cramps in the muscles of the leg, with great muscular hyperæsthesia, follow, and the muscles of the upper arm are also sometimes similarly affected; this is a very diagnostic symptom, and is not present in anchylostomiasis. Dropsy and œdema are never very prominent symptoms, as they are in the Ceylon disease.

The motor paralysis is progressive, affecting the several muscles mainly, and producing the characteristic gait of this affection; the foot is lifted perpendicularly from the ground and then jerked out from the knee, coming to the ground again with a sort of "flop"; these movements, dependent on the thigh muscles, are subsequently modified from failing power, the legs being jerked outwards and the gait becoming straddling. The power of locomotion then fails entirely, then the power of the hands and arms fails, and the laryngeal muscles become affected, the voice being muffled and characteristic. The diaphragm, ultimately, is involved, respiration interfered with, and sudden death is then frequent. The duration of the paralytic symptoms is variable—brief or pro-

longed. The involuntary muscles are unaffected, and the control of the bladder and rectum is never lost.

Anæmia is not a frequent symptom; hydropericardium is, however, a frequent cause of death, even in an early stage of the disease; pulmonary œdema is a late and fatal complication. Intractable ulceration of the feet and legs is frequent. Hæmorrhages, intestinal or cerebral, are rarely, if ever, met with.

Anchylostomiasis and the beri-beri of the Straits Settlements have many points in common, but typical cases of each are readily distinguished. It is a question if the two affections may not exist in the same individual.

Prognosis is grave, the disease is very intractable, and a mortality of 20 per cent. is noticed in hospital cases in the Straits Settlements.

The disease has been termed wet or dry, according to the presence or absence of dropsy; acute or chronic, according to duration—all arbitrary and inconstant divisions. One noteworthy fact, as far as Mr. Gimlette has had an opportunity of observing, is, that the paralysis is very occasionally unilateral. *Post-mortem* examinations yield negative results; the pericardium always contains an excess of fluid; the intestines show the signs of irritation due to the presence of anchylostomata, which are always present in greater or smaller numbers, this parasite being found to infest the intestines of nearly all Chinese coolies.

Treatment.—Improved sanitary conditions as a prophylactic; improved diet, with a suitable amount of nitrogenous elements and vegetables, has proved curative. An antiscorbutic regimen has proved most successful in the Singapore Pauper Hospital, and an improved dietary is reported by Takaki Kanehiro, F.R.C.S.Eng., Medical Director-General of the Imperial Japanese Navy, in his Annual Report for 1887, to have banished Kak'ke from that navy, which has a force of 9,106 men.

LEPROSY: A REVIEW OF SOME FACTS AND FIGURES.

By PHINEAS S. ABRAHAM, M.A., M.D., B.Sc., F.R.C.S.I.,

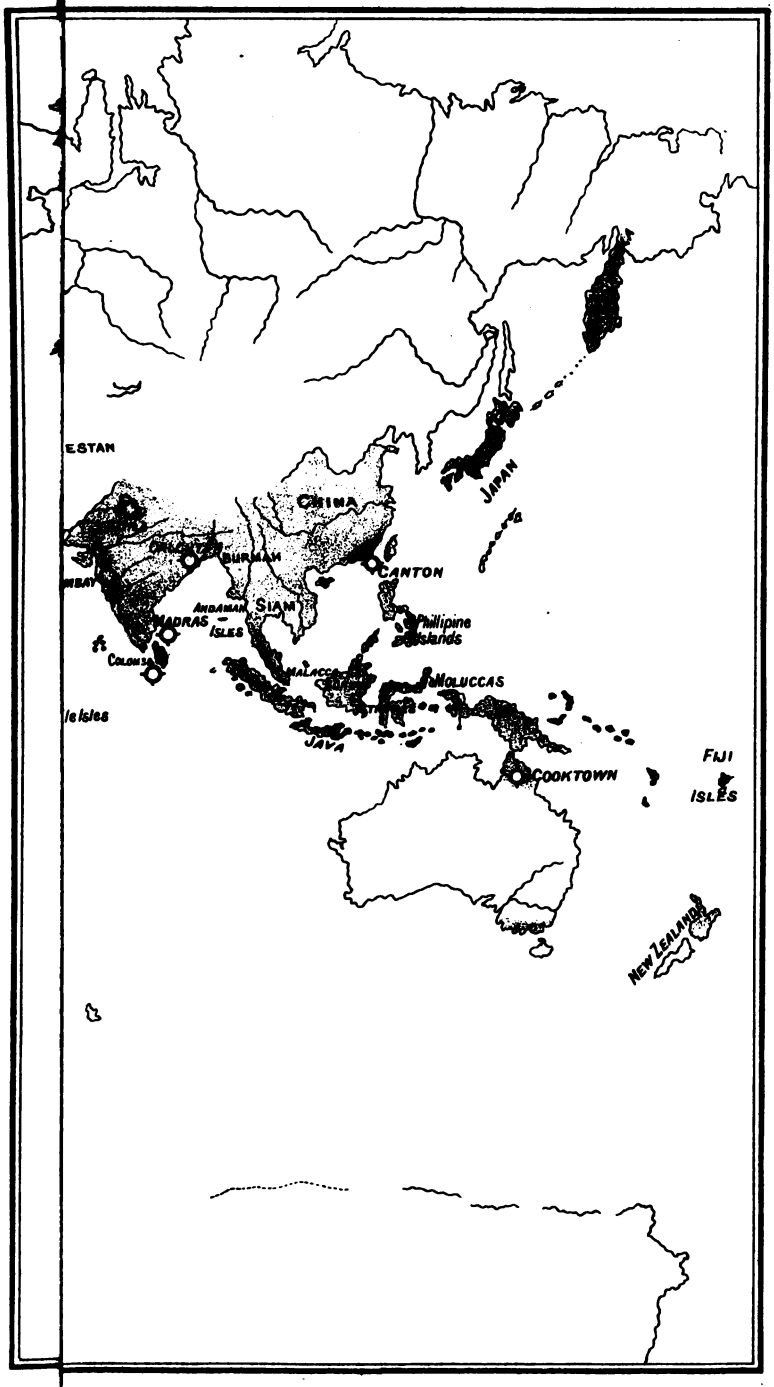
Lecturer on Physiology and Histology, Westminster Hospital Medical School; Clinical Assistant, Hospital for Diseases of the Skin, Blackfriars; and late Curator of the Museum and Member of the Court of Examiners, R.C.S.I.

(*Read: May 8th*, 1889.)

MR. PRESIDENT AND GENTLEMEN,—When the Hon. Secretaries of this Society did me the honour to invite me, some time ago, to read a paper, it occurred to me that I could not choose a more suitable subject to bring before you than that of leprosy; for not only is the question of the spread of that disease now attracting considerable attention in medical circles, but I feel that no scientific body is better qualified to discuss and throw light upon the matter than the Epidemiological Society, of which so many members are distinguished by their wide experience of Oriental and colonial endemic disease.

Within the last few years we have seen numerous articles, annotations, and letters on leprosy in non-medical magazines and in the daily press; and the medical journals of this country, of the Continent, and of America have frequently alluded to the subject in their columns. There have also been papers and discussions on leprosy at the late International Congresses, as well as at the Académie de Médecine at Paris, in 1885 and 1888, and at the Academy of Medicine of New York, and at meetings of physicians in Germany and in Russia; but, with the exception of the case brought forward by Dr. O'Carroll, a few weeks ago, at the Royal Academy of Medicine of Ireland, I believe that no British Society has recently had the subject under its consideration.

That the disease is really to be regarded as of importance in British medicine is forcibly indicated by the fact that the Royal College of Physicians of London has its "Leprosy Committee"; and as we learn from the Report of that body adopted by the College at its recent meeting (April 17th,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FIJI
ISLES
NEW ZEALAND

1889), in view of the fact that there is increasing evidence respecting the communicability of leprosy, the Committee repeated, "with greater urgency, the recommendation made in 1887,* that the Government should institute a full and careful scientific investigation, which would entail expense and require considerable time."†

A glance at the map, which indicates the distribution of leprosy throughout the world, will show the wide prevalence of the disease in the British Empire; and if it be true that the pestilence is increasing in some countries, and that it may possibly become endemic in other places which are now exempt, it is not to be wondered at that the subject is coming to the front, and that a great deal of general interest in the matter is becoming manifest.

It is to be hoped that the scientific investigation of leprosy which the Committee of the Royal College of Physicians recommends will be sanctioned by the Government; for not only will it be desirable to set at rest, if possible, a great many doubtful points with regard to the pathology, etiology, and the desirability of preventive measures, etc., but also because we know that the British public, or at any rate a large section of it, is rather liable to an occasional emotional outburst, which may take the form of a general scare, and that anything of the kind will probably be best allayed by the authoritative conclusions of a proper commission.

Leprosy in the British Dominions.

The question whether leprosy be really increasing in our colonies is one by no means easy to answer definitely. The medical reports of those countries or islands where the disease is endemic, and particularly where leper asylums have been established, have as a rule, but not always, some reference to the disease; but the facts and data given are usually quite insufficient for arriving at any sound conclusion on the point.

The Cape.—In a few places special attention has been directed to the subject; and, as at the Cape of Good Hope, we have amongst the recent Government papers numerous expressions of opinion from district medical officers and other authorities. The belief, indeed, in the increasing spread of leprosy in South Africa became so general that, a few

* Leprosy Committee Report, 1887. See Appendix V.
† *Lancet*, April 20th, 1889.

years ago, an Act was passed, entitled "The Leprosy Repression Act, 1884".*

In the South African Reports for 1886 a decided increase is stated to have taken place in the districts of Alexandria, Bedford, Clanwilliam, Herschel, Malmesbury, Paarl, and Stockenstrom; and for 1887 the spread of the disease is reported not only from most of these districts, but also from Wynberg, Stutterheim, and Koksted. The majority of the medical officers speak very strongly on the subject. For example, one of them (from Alexandria) writes that "leprosy is certainly spreading rapidly, and unless some active and efficient measures are soon taken, it will become a matter for the most serious consideration." Another (from Bedford): "I believe it to be considerably on the increase, and should be stringently dealt with." Another (from Malmesbury): "With reference to leprosy, I cannot but repeat my statements of the last years to the effect that the disease is slowly but surely increasing, each fresh case acting as the nucleus to a more or less extended infection." Another (from Paarl): "It is deplorable to see what strides it is making"; and in 1887, "As for leprosy, although it is making rapid strides, there is no notice taken of it" (*i.e.*, by the authorities). More than one of these medical authorities, indeed, assert or imply that the boards of management, and others, who have the power to put the Act in force, shirk the duty on the score of expense, and that the Public Health Act is to some extent a dead letter.

In reference to this, however, the medical committee of the Cape state that "they see with pleasure that a commencement has been made regarding a segregation of lepers, and strongly recommend that the law as passed be promulgated without delay, especially as the opinion that leprosy is contagious is gaining ground, and therefore consider that every means should be adopted to eradicate this very loathsome disease as soon as possible."†

The Cape leper asylum is located, with the lunatic asylum, at Robben Island, in Table Bay.

In Dr. Daubler's account of a recent visit to the Cape asylum,‡ we learn that there are now§ 84 lepers at Robben Island—58 males and 26 females; of the latter 6 are white people, and 5 half-castes. Of the whole 58, 3 are born Europeans. About one-third of the number are half-castes, and a great many of the remainder are Malays. The

*. *See* Appendix III. † Cape Reports for 1886.
‡ *Monatshefte für prac. Dermat.* (*Unna*), Feb. 1889, p. 123.
§ October 1888.

asylum is not large enough for the requirements of the Cape.

It is believed that leprosy was introduced at the Cape by Malays imported by the Dutch at the beginning of the last century.

He states that in the Transvaal there are lepers both white and black, and that the native chiefs of the Limpopo districts, and others, have petitioned the Government to establish asylums, but their request has not been granted.

According to Surgeon Brunt, R.N., of H.M.S. *Flora*—whose recent interesting Report on Leprosy at the Cape, Deputy Inspector-General Turnbull, M.D., R.N., has kindly enabled me to peruse—"leprosy is greatly on the increase in this colony, and, although it is principally confined to the black population and half-castes, or 'bastards', as they are called here, there are also frequent instances of the disease having been contracted by Europeans."

But little information, however, can be obtained from the official reports of most of the other leprous countries; and, even in the census and death returns, the data given in reference to leprosy are very scanty. Indeed, in those places where an attempt has been made to record the number of existing lepers, or the number of persons who have died from the disease, the figures are unreliable, and probably much under the mark—first, because of the general tendency to conceal the disease, and, secondly, because the vast majority of deaths are uncertified by medical men.

JAMAICA.—Thus, in Jamaica, the colony with which I happen to be personally acquainted, it has been estimated that upwards of 75 per cent. of the total deaths in the island are not certified by qualified practitioners!*

The Registrar-General's returns give the following deaths from leprosy in that island for the last ten years:—

1879-80	33	1884-85	37
1881-82	34	1885-86	26
1882-83	29	1886-87	39
1883-84	26		

If we cannot arrive at any judgment as to the increase or decrease of leprosy from these figures, we can still less from the census returns, which are—

For the year	Population.	Lepers.
1861		778
1871	506,154	749
1881	580,804	No return of lepers.

It would be as well if the attention of the colonial

* Jamaica Census, 1881.

authorities were called to the desirability of obtaining more definite records of the disease in future censuses.

Jamaica possesses a lepers' home at Spanish Town, where the afflicted may voluntarily go, and to which vagrant lepers may be sent. Here cases of frambæsia, elephantiasis arabum, psoriasis, etc., are received, as well as of leprosy. The number of cases of the latter treated in the home were—

In 1879-80	66	1883-84	105
1880-81*	90	1884-85	103
1881-82*	101	1885-86	110
1882-83	105	1886-87	104

My friend Dr. Phillippo, of Kingston, who is one of the most experienced practitioners in the colony, has given me his opinion as follows: "I do not believe that the disease has increased during the last thirty years; it has not certainly among the whites, and I do not think that it has amongst the coloured people."

On the other hand, I understand that Dr. A. R. Saunders, who has been fourteen years in large practice in the island, and Dr. T. P. Madden, consider that it is decidedly on the increase, both among the whites and coloured, as well as the blacks. It will be seen that these opinions cannot be verified by figures.

TRINIDAD.—The fullest information with regard to leprosy in the West Indies, perhaps, comes to us from Trinidad; but even here we have no adequate data. Dr. Beaven Rake, medical superintendent of the asylum, whose full and able reports and important pathological researches are well known, writes to me, under date March 29th, 1889: "1. *Increase of Leprosy in the West Indies.* I regret that statistics on this point are very meagre. I have urged on the Government the desirability of getting periodical returns of the number of lepers, but nothing has been done yet. The number of lepers in the asylum is hardly any guide, for the beds are nearly always full, and there are numbers waiting outside. I, however, give you the following figures for what they are worth:—

"On January 1st, 1869, there were	70	lepers	in	the	asylum.
„ Dec. 31st, 1873	„ 86	„		„	
„ „ „ 1881	„ 128	„		„	
„ „ „ 1887	„ 176	„		„	

Thus in twenty years the number of beds in the asylum

* The increase is in consequence of the leprosy law in reference to vagrants being enforced in the different parishes.

has been more than doubled. Comparing the census of 1881 with the *estimated* population at the end of 1887, we have—

	Population.	Lepers in Asylum.	
1871	109,638	89	
1881	153,128	128	or roughly $\frac{143}{153} \times \frac{128}{176}$
1887	183,406	176	

This shows the increase of lepers in the asylum to be out of proportion to the increase of population."

In 1884 Dr. R. H. Knaggs (late acting medical superintendent of the leper asylum) expressed the opinion that the disease was increasing in the colony, and that there were double the number of lepers outside the asylum; but this was doubted by the Surgeon-General,* who states: "There has not been any systematic inquiry as to the number of lepers in the colony, and we are not placed in a position to know the relative numbers in and out of the asylum, at the present or any previous period."

Dr. Rake, however, seems to think that there has been a more rapid increase in later years.

In the work, *La Lèpre est Contagieuse*,† the rev. author‡ shows the enormous growth of the disease in Trinidad since the beginning of the century; and he is evidently a strong believer in its present increase, not only in Trinidad, but in many other parts of the world.

BRITISH GUIANA.—There have also been many excellent reports concerning leprosy from the medical officers of British Guiana; and amongst them the careful and valuable work§ by Dr. Hillis, formerly of Demerara, must be particularly referred to. Conclusive official statistics, however, relating to the increase or decrease of the disease are not extant. At the time he wrote Dr. Hillis believed that 1 in 500 of the population was leprous. The figures given for 1831 are 431, 1864 are 529, and for 1879, 525; but he is of opinion that these latter are inaccurate. He considers that while there has been an increase of 160 per cent. of the cases of leprosy in the twenty years 1858-78, the increase of population has been only 45 per cent.

The Surgeon-General of the colony, Dr. Manget, stated in 1879 that "leprosy is on the increase among the Creole population, but the coolies are those who by far add to the number."

* *Vide* Council Paper, Surg.-Genl.'s Office, 3rd June 1884.
† Paris, 1879.
‡ ? Père Etienne, O.P. Sec. Hillis, *Leprosy in Brit. Guiana.*
§ *Leprosy in British Guiana*, London, 1881.

The reports for the last few years give—

Jan. 1st,	1884,	cases in the	asylum,	200
„	1885	„	„	268
„	1886	„	„	303
„	1887	„	„	322
„	1888	„	„	365

Cæteris paribus, these figures indicate a marked increase; and Dr. Castor, the present medical superintendent of the asylum at Mahaica, writes, in his last report (for 1887), "I hear on all hands that leprosy is spreading—not only here, but all over the world—very considerably."

From the other West India Islands we have rather meagre particulars in reference to leprosy.

BARBADOES.—The report of the leper hospital at Barbadoes for 1868 states that "with a daily average of 80, there have been 16 admissions and 7 deaths; total deaths for the year, 15." For 1887 we learn that "with a daily average of 83, there have been 5 admissions and 3 deaths. Two patients have left the asylum during the year."

The census returns, however, give us some useful information on the subject:—

	Population.	Lepers, Inmates.	Not Inmates.		Total.
In 1871	162,072	86	10	=	96
„ 1881	171,452	108	12	=	120

These figures show an increase of the disease in the last ten years, for while the population has grown to the extent of only about 6 per cent., the lepers have multiplied 25 per cent.

In the Leper Asylum at Antigua there were 29 cases on the 31st December 1886. Ten fresh ones had been admitted during the year, 4 were discharged, and there were 2 deaths.

At the Leper Asylum at St. Vincent there were 19 cases at the end of the year 1887; 8 being admitted during the year. Three had died, and 5 left for their homes.

One case of leprosy is mentioned in the hospital report, 1882, of Tobago, 3 at Dominica in 1885, and 1 at Grenada in 1887.

NEW BRUNSWICK.—With regard to British North America, there is still a leper asylum at Tracadie, in New Brunswick, but I can find at the Colonial Office no official data relating to it, nor any reference whatever to the disease in the latest Government reports. The Canada census returns give five deaths from leprosy for 1871, and four deaths (three in New Brunswick and one in Nova Scotia) for 1881.

A very good account, however, up to the year 1885, is to be found in *Leprosy in Foreign Countries*, Honolulu, 1886,

where, in their replies to the inquiries of the Hawaiian Government, Drs. Graham, Tache, and A. C. Smith all declare the diminution of the disease in New Brunswick. At one time there were as many as forty lepers in the lazaretto. The tables which accompany the report for Canada give the following numbers for eleven years:—

	Lepers in Lazaretto at Tracadie.	Lepers Outside.	Total in New Brunswick.
1875	21	17	36
1876	22	16	36
1877	16	19	34
1878	15	16	30
1879	18	12	29
1880	16	12	27
1881	16	13	28
1882	22	8	29
1883	26	5	30
1884	23	5	27
1885	22	4	25

It appears that a new leper centre has recently developed in British Columbia, amongst the Chinese immigrants.

INDIA.—Leprosy in our Eastern empire has for many years occupied the anxious thought of the Government of India. The valuable special reports, which have been published from time to time by Dr. Vandyke Carter and Drs. Lewis and Cunningham are particularly interesting and important.

According to the census of 1872, there were 99,073 lepers in British India, the proportion to the whole population being 5·4 in 10,000.

The census of 1881 gives the following numbers:—

	Males.	Females.
Madras	10.329	3,846
Bombay	7,525	3,369
Bengal	40,484	13,400
N.W. Provinces and Oudh	14,473	3,369
Punjab	4,459	1,206

The total for all India amounted to 131,618 lepers, of whom 98,982 were males and 32,636 females. In the opinion of the authorities, these figures do not "afford a true measure of the extent of the disease",* and it is probable that the numbers given, for the females especially, are much understated.

It is estimated that only about one per cent. of the lepers of India are located in the twenty-three asylums, hospitals, or special wards now established for their reception. The actual numbers given from 1887 are—

* Resolution of Government of India, Simla, 26th Sept. 1888.

Province.	Number of Leper Asylums or Wards.	Patients Treated.
Madras	3	438
Bombay	7	506
Bengal	3	275
N.W. Provinces	3	262
Punjab	7	517
	Total	1,998

One of the highest medical and statistical authorities in the Indian Government has recently stated that he does "not know of any good ground for believing that leprosy is increasing in India, or that it is diminishing". As in most of the other leprous countries, we can only fall back upon general impressions.

In 1875 the commissioner, General Sir H. Ramsay, wrote: "It appears to be wrong that this fearful disease should be allowed to continue to spread itself among the population, if any measures can be taken to prevent it."* Messrs. Lewis and Cunningham, however, in their report on the Kumaon district of the N.W. Provinces, came to the conclusion that "any risk of rapid increase in Kumaon is not to be apprehended".† Their impression was that leprosy was probably decreasing in that district. The census returns give—

In 1852, 1,075 lepers, or 2.98 per 1,000.
In 1863, 1,128 lepers, or 2.85 per 1,000.
And in 1872, 798 lepers, or 1.94 per 1,000.

These figures, however, are admittedly inaccurate.

In the Bombay Presidency it was estimated that in 1871 the proportion of lepers to healthy people was one per thousand; but the actual figures cannot be quoted, for while a total of 8,052 is given for "true leprosy" in ten districts, in three others the statistics (giving a total of 2,611) include both "true" and the so-called "white" leprosy.‡

A more thorough attempt was made in 1880 and 1881 to determine the number of lepers in the Bombay Presidency. The figures are—

Northern Division		1,900	Southern Division		790
Central	„	6,768	Sind	„	25
				Total	9,483

The lepers in the city of Bombay, however, and in Ratnágiri, where there is also an asylum, are not included in this number. It is probable that there must be altogether in the province some 11,000 or more.

* *Leprosy in India*, Report of Lewis and Cunningham.
† *See* reprint of *Lewis's Researches*, p. 482.
‡ Dr. Vandyke Carter's Report for 1871.

From the papers which have arrived by a recent mail, we see that an important discussion on leprosy has taken place lately in the Bombay corporation, and Dr. Blaney, the coroner for Bombay, strongly asserted that "leprosy in Bombay was vastly increasing".* His official position as coroner enabled him to adduce some startling facts. Every year he gave orders for the disposing of the dead bodies of ten, twelve, or fifteen lepers, some of whom had died on the road-side. Some of them drowned themselves, and he did not think there was a single well in which a leper had not been drowned.

The articles, moreover, which are now appearing in the Anglo-Indian press† indicate that the public mind is becoming somewhat inflamed over the matter; and that there is some cause may be inferred from the large amount of official attention which has been for some time past, and is now, directed in India to the question of segregation.

For many years Dr. Vandyke Carter has been urging the importance of collecting yearly "leper statistics", and of establishing leper hospitals and asylums in the most affected districts;‡ but until now his recommendations have been scarcely at all carried out, chiefly, it seems, on the ground of cost. Thus in the *Government Proceedings*, 1882, we read: "It is evident that provision cannot be made for all the lepers in the Presidency except at a very great cost—so great that, however much his Excellency the Governor in Council may wish to alleviate the sufferings of lepers, he cannot undertake to meet the whole of the expenditure with due regard to other claims on the public revenues."

From the lately adopted resolution of the Government of India (Simla, September 1888) we learn that "the possibility of the State taking a more direct part in the prevention or treatment of leprosy has recently been under the consideration of the Government of India; and with a view to ascertaining precisely the facts regarding persons known to be affected with leprosy, who seek relief at the various leper asylums, etc., local governments and administrations were requested to furnish information as to the number and sex of such lepers, their treatment, especially with regard to the separation of sexes, and other available particulars. . . . . The Governor-General in Council is assured that no measure could effectually stamp out the disease which stopped short of the absolute segregation of the sexes, and the confinement for life of all affected by it. Such a measure would not only

* *Times of India*, April 12th, 1889. *See* Appendix I.
† *See* Appendix II.
‡ *Vide* Reports, 1871, 1874, 1876, 1884, etc.

be repugnant to public opinion at the present time, but would in India be perfectly impracticable. After carefully considering the subject, his Excellency in Council has arrived at the conclusion that, for the present at all events, it is impossible for Government to attempt to do more than encourage the grant of medical and charitable relief to lepers in voluntary hospitals and leper asylums. In affording medical relief in such institutions the necessity of strictly enforcing the segregation of the sexes should be invariably kept in view; and his Excellency in Council desires that this condition should be imposed in the case of every institution for the relief of lepers which receives aid from public funds, and that every effort should be made to induce supporters of institutions of the kind maintained by voluntary contributions to adopt a rule of similar strictness."

It appears that at the present time five of the Indian leper asylums are maintained partly, and nine entirely, by public funds. In the central provinces and in Burma most of the leprous patients are treated in general hospitals and dispensaries. Segregation of the sexes is carried out in the leper hospitals in Madras (Madras, Cochin, and Trichinopoly), Bengal (Calcutta, not strictly at Lohardagga), in the North-West Provinces (Agra, Almora, and Dehra Dun, but not in several other institutions which receive lepers); it is not, however, enforced in Bombay or the Punjab.*

With regard to the remaining British dependencies in which leprosy is now endemic, the available official data are not abundant.

CEYLON.—An interesting account of leprosy in this colony was given by Dr. Kynsey† in 1885. No restriction or segregation is there imposed, although there is an old-established asylum near Colombo with a daily average for the last five years of 125 inmates. Dr. Kynsey writes: "The disease, I have reason to believe, has decidedly increased since 1862, as the number of patients then in the asylum was 63, but it has since increased to 151. Its increase among the general population cannot be established with precision, owing to the absence of an exact registration enumerating lepers. Cases of strictly recent origin are relatively more frequent, judging from the admissions into the asylum and the numerous instances that have come under my personal observation among the general community."

* From papers recently circulated in India, for the perusal of which I have to thank the authorities at the India Office.

† *Leprosy in Foreign Countries: Summary of Reports*, Honolulu, 1886, p. 161.

MAURITIUS.—According to Dr. Suzor,* at the present time hundreds of lepers can be counted without difficulty, of all races, even Europeans.

The following facts are gathered from the "Administration Reports" for 1887 :—

St. Lazare Asylum (p. 532).—Number of lepers maintained in the institution at expense of Poor Law Commission, 296, against 321 in the preceding year; being of general population, 111, Indians, 185. *Out-door lepers* receiving relief (except in one district), 109, instead of 104 in preceding year, viz :—

	Males.	Females.	Total.
Of the general population ...	28	16	44
„ Indian „ ...	52	13	65
			109

Report of Civil Hospital (p. 568).—Lepers received, 5 (all Indians); discharged, 4; remaining (December 1st, 1887), 1.

Vital Statistics (p. 982).—"*Leprosy.*—To leprosy are yearly attributed a certain number of deaths; it is, however, feared that some deaths from this disease are declared under other causes when occurring in country districts."

In 1878 there were		93	deaths from leprosy.
1879	„	105	„
1880	„	66	„
1881	„	86	„
1882	„	103	„
1883	„	95	„
1884	„	61	„
1885	„	98	„
1886	„	79	„
1887	„	68	„

AUSTRALIA.—There have been rumours that leprosy had been introduced into Australia by Chinese coolies. My friend Dr. S. Knaggs, of Sydney, has informed me that little or nothing is ever seen or heard of the disease, in New South Wales at all events. Dr. Clowes, however, tells me that there have been Chinese lepers retained in quarantine at Sydney. I learn also from the office of the Agent-General for South Australia that the disease is quite unknown in that colony; and this fact is the more interesting, seeing that there are between 4,000 and 5,000 Chinese, as well as some Malay and Cingalese, immigrants in the Northern Territory.†

At the office of the Agent-General for Queensland I could

* *Progrès Médical*, 1886; article translated by myself for *Internat. Ann. Surg.*, 1887, p. 324.

† *The Northern Territory*, by Hon. J. Parsons, Adelaide, 1887.

obtain no information on the subject; but I have elsewhere learned that there are several lepers, mostly Chinese, at a hospital at Cook Town. In Surgeon Brunt's report, previously referred to, it is also stated that leprosy has made its appearance—with the Chinese—at Hangi Banji, north of Australia.

It appears that in Queensland there are some 9,000 Chinese.

In Victoria, however, the matter is engaging some notice; for in the Report of the Central Board of Health of that colony for 1888, p. 22, we see the following paragraph: "As regards leprosy, which appears to be on the increase in some parts of the world, we may remark that only one Chinese leper now remains in Middle Quarantine Station, one man having died since our last general report. Four others are on the goldfields, cared for to some extent by their countrymen, and fed at the cost of the State. The increase of leprosy is of considerable interest to the Australian colonies, in view of the number of Chinese, Malays, and Hindoos who arrive from time to time."

It was estimated in 1887 that there were no less than 11,967 Chinese in Victoria.

NEW ZEALAND.—I can find no information in the last Report (1888) of the Hospitals and Charitable Institutions of the colony. The disease is not mentioned.

Dr. Haines, who is in large practice in Auckland, informs me that he has never seen or heard of a leper in New Zealand. Many years ago, there were a few cases in the hospital at Auckland, and Dr. A. Thomson, who identified the disease in New Zealand, met with several instances among the natives.

HAWAII.—Concerning the leper-stricken countries which are not British, we have probably heard more about the Sandwich Islands than of any other in recent years. The public mind, indeed, all over the world, has been deeply moved at the terrible fate of Father Damien, who has been slowly but surely going to his death in the noble discharge of his duty.* The story of the supposed introduction of the dreadful disease by a Chinese coolie, some forty years ago, has been often told, doubted, and now it seems it must be finally discarded. Dr. Gavin Milroy in 1873† showed that Dr. Hillebrand, who was the author of the theory, might have been mistaken in his belief: and it has since become accepted in Honolulu that there had been previous cases of leprosy, which had probably been confounded with other diseases.

* A few days after this paper was read came the news of this devoted martyr's death.

† *Report on Leprosy in the West Indies.*

In the last Biennial Report of the President of the Hawaiian Board of Health (1888), just to hand, we read, "Leprosy was first clearly made out to exist in this country about the year 1840, in the person of one Naea, a messenger of the chiefs, who died in 1852. The friends of the deceased thought that he had the disease for about ten years before his death. His case was reported by Rev. D. Baldwin, M.D., of Lahaina, in a communication to the Minister of the Interior, Honourable C. G. Hopkins, dated May 26, 1864."

The attention of the Hawaiian Government was first called to the subject by Dr. Hillebrand, in 1863, who spoke of "the rapid spread of that new disease called by the natives 'Mai Pake'," which he believed was the genuine Oriental leprosy. He had "followed its gradual spreading from a single person to many people in the same village"; and although its contagiousness did not seem to be strongly developed, it was "sufficiently marked to warrant the application of some radical sanitary measure". An "Act to Prevent the Spread of Leprosy" was, in consequence, passed on the 3rd January 1865, its provisions sanctioning (1) the reservation of "a site or sites of an establishment or establishments to secure the isolation and seclusion of such leprous persons as, in the opinion of the Board of Health or its agents, may, by being at large, cause the spread of leprosy"; (2) the acquisition of land for that purpose; (3) empowering the arrest and detention of lepers; (4) the establishment of an additional hospital "where leprous patients in the incipient stages may be treated in order to attempt a cure"; and 5, 6, and 7, sections relating to rules and regulations, expenses, etc.

As the result of this Act, a temporary hospital was established at Kalihi, on the island of Oahu, near Honolulu, and a settlement for confirmed cases, at Kalaupapa, on the island of Molokai.

Forty-three patients were forthwith received at Kalihi, and many more soon afterwards. In the Report of 1866 it is stated that up to that date 234 persons had been examined at Kalihi, of whom 76 were discharged as not being lepers, and 57 sent on to Molokai. We learn from this report that the total number of persons in the kingdom then "represented as afflicted with the disease" was 274; but there was reason to believe that a few still remained concealed by their friends.

At Molokai the number entered up to March 31st, 1868, was 179; discharged, 6; died, 47; and at the asylum at that date, 126.

In a letter dated July 8th, 1873, Dr. Trousseau stated that

he had examined, since the 1st of March, over 1,000 people, and that 410 had been sent to Molokai. The number at that settlement then was about 800, and he declared that there could not be more than fifty other cases at large in the Hawaiian kingdom. Altogether, at that time, about 2 per cent. of the native race were affected.

The Report for 1876 gives 1,570 as the number of lepers received at Molokai in ten years, from 1866 to 1876; total deaths, 872; and remaining, 698 (or 706, according to Dr. Mouritz' Report, 1886). Dr. Mouritz' statistics, compiled from the books of the asylum, show that—

In 1878 there were 692 lepers at the settlement.

On the 1st January		1880	...	...	...	717
„	„	1881	...	...	...	606
„	„	1882	...	...	...	706
„	„	1883	...	...	...	646
„	„	1884	...	...	...	784
„	„	1885	...	...	...	717
„	„	1886	...	...	...	658

The last Biennial Report, which arrived in England by the late mail, gives the following tabular statement of the leper population at Molokai up to last year:—

	Males.	Females.	Total.
Population, April 1st, 1886 ...	426	227	653
Added	208	113	321
	634	340	974
Deaths	139	86	225
Population, March 31st, 1888 ...	495	254	749

As may be supposed, "accurate statistics as to the number of lepers still at large" cannot be obtained; but it has been estimated that on March 31st, 1888, there were at least 644 lepers scattered throughout the various islands of the kingdom. The gross number of lepers, therefore, in the Hawaiian kingdom in March 1888, was approximately 1,400.

It appears that there has always been great difficulty in the Sandwich Islands in carrying out a full measure of segregation. This fact comes out in several of the reports; and in the latest of them* we see it stated that for some period during the administration as President of the Board of Health of Mr. Gibson, who apparently doubted its efficacy, "the work of segregation had been practically brought to an end". At the present time there is an endeavour to enforce rigorously the isolation of lepers.† Since 1882 a branch hospital has been

* *Biennial Rep.*, 1888, p. 8.

† *See* Appendix IV, "Copy of Act to Facilitate the Segregation", etc.

established at Kakaako, near Honolulu, where suspected cases of leprosy may be detained, the institution at Kalihi being abolished.

In EUROPE, where, as we all know, it was formerly common, leprosy as an endemic disease has not yet disappeared from the countries of Scandinavia. It is also to this day, more or less, to be found in certain districts in Spain and Portugal, the Riviera, Sicily, Greece, Turkey, and the neighbouring islands, including our British possession Cyprus, and to some extent in South Russia and a few other places.

NORWAY is still a large centre, and the most elaborate observations published on leprosy come from that country The classical work, indeed, of Messrs. Danielssen and Boeck* was the first comprehensive treatise on the subject. The Norwegian statistics in reference to leprosy have always been compiled with the greatest care; but nevertheless they, even, cannot be regarded as *absolutely* accurate; for there, as elsewhere, lepers and their friends hide their affliction as long and as much as they can. In 1856 leper hospitals and asylums were first established, and from that time date the attempts at segregation which have been accompanied by such good results in the diminution of the disease. There were probably in that year nearly three thousand lepers in Norway, and as the accompanying curve† graphically shows they have been steadily diminishing ever since, until at the present time there are probably not 1,100 in the whole country.‡

Last summer I had the opportunity of visiting the leper asylums in Bergen, Molde, and Trondhjem; and I take this opportunity of thanking Dr. Danielssen, of the Lungegaarde Hospital, Dr. Nickoll, of the Spedalske Pleiestiftelse, No. 1, Dr. Kaurin, of the Reknæs Pleiestiftelse, and Dr. Sand, of the Reitgjærdets Pleiestiftelse, for their extreme courtesy in allowing me to examine the patients, and for their kindness in furnishing me with a great deal of valuable information on the subject in general.

At the Lungegaarde Hospital, in Bergen, there were about eighty patients, most of them being more or less slight cases, and some of them, in Dr. Danielssen's opinion, capable of being benefited to some extent by treatment.

The severer cases at Bergen are retained in the Pleies-

* *Traité de la Spedalsklied ou Eléphantiasis des Grecs*, Paris, 1848.

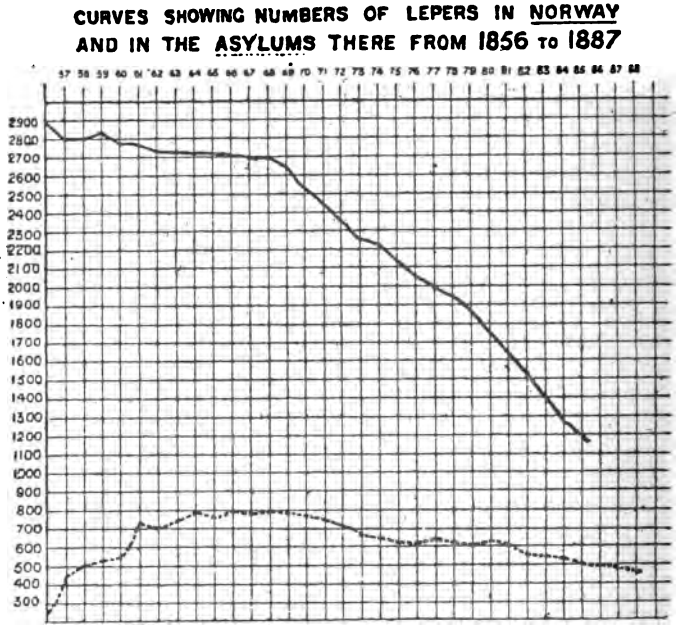
† Dr. Kaurin of Molde kindly allowed me to copy this, as well as his map of the distribution of leprosy.

‡ The *Norges Officielle Statistic*, in Report for 1881-85, which was published in 1888, gives 1,195 for the end of the year 1885.

tiftelse, No. 1, which at the period of my visit had some 150 on the books.

At the Reknæs Asylum, at Molde, there were 73 cases, and at Trondhjem, under Dr. Sand's care, 190, make a total of rather less than 500 lepers in the Norwegian asylums.

Leprosy is generally believed not to manifest itself in very old patients.* I was therefore much interested in observing the very advanced age of some of the sufferers I saw in Norway. At Trondhjem there was an old couple—husband and wife—each seventy-four years of age; the woman had



been diseased for four or five years, and the man for three years. No other members of their family were, or had been, affected. Another case was that of a woman aged eighty-one, who became afflicted with the neoplastic dermal form of the disease four years previously. In the same asylum was a man aged eighty-seven, who had only been leprous for two years; and at Bergen I also saw a woman of eighty-four, who had not been affected for more than three years.

* Danielssen and Böeck put the limit at seventy years.

There were very few children in the Norwegian asylums. At Molde was the boy who had contracted the disease after sleeping for a year in the same bed with a leper, and whose case has been recorded by Dr. Kaurin.* Two cases at Trondhjem had been leprous at or shortly after birth; but in Norway, as elsewhere, the disease is very rare in young children. I observed a few instances in which the symptoms had ceased for some years, all progress of the disease arrested, and the patient practically cured—of course with more or less loss of tissue and deformity. A woman at Molde, whose leg had been amputated, had remained quite well for seven years. Dr. Kaurin was inclined to think that in some cases, where the neoplasm was localised, early amputation might stop the disease. It is remarkable how readily the tissues heal in lepers after operation—a fact that Dr. Beaven Rake has called attention to in some of his reports.†

At Trondhjem I saw a woman who had shown no signs of active disease for fourteen or fifteen years; her permanently "clawed" fingers were the only evidence of its having been present.

Dr. Sand is of opinion that in some cases, if the constitution be very strong, the disease wears itself out in thirty or forty years—its progress, in fact, virtually stopping. When it begins in early life its duration is generally shorter.

The late Official Report states that thirty-eight cases have been cured in the five years 1881-1885.

In Norway the unfortunate lepers are not left to rot, as in many other countries. Although there is at present no specific, and therapeutic measures have there been found to have little or no effect in curing the disease, it has been abundantly proved that many symptoms may be mitigated, and life prolonged and rendered easier, especially by surgical aid. I was shown numerous cases of amputations and tracheotomies. One patient at Bergen had worn a tube for three years, another for seven years, another at Trondhjem for ten years, and a great many others in all the asylums for shorter periods. In one case at Trondhjem the larynx subsequently became functionally useful, and the tube was discarded and the opening closed. According to Dr. Sand, when the nodular growths of the skin are removed they do not return; but they may in the case of the conjunctivæ. Dr. Kaurin informed me that keratotomy sometimes saved a cornea, a growth on the sclerotic not extending across the incision. Others have not been so successful with this operation. Dr. Danielssen and

* *Ann. de Derm. et Syph.*, Feb. 1887.
† 1885 and 1887, and *Lancet*, Sept. 1886.

most of the Norwegian surgeons have found tracheloraphy useful for the distressing paralytic ectropion which is so common.

Dr. Sand exhibited to me cases and casts of others, from which Dr. Heiberg, of Kristiania, had described his so-called "lepra mutilans"*—the variety of the disease characterised by spontaneous amputations of the feet, hands, or digits, without muscular atrophy or extensive superficial anæsthesia. In these cases he believes that only, or chiefly, the trophic nerves of joints are affected, and not the sensory nerves, as in the ordinary so-called anæsthetic variety. So many cases of leprosy, however, show spontaneous amputation, together with interstitial trophic changes, in the bone and other tissues of the affected limb, as well as extensive anæsthetic areas, that the distinction appears to me to be a little far-fetched.

The isolation of lepers in the Norway asylums is not absolute. The doors and gates of the institutions are not locked, and more than once I met some of the inmates in the neighbouring roads. The doctors informed me that they allowed those to go out who showed no ulcerations, and that no cases of consequent infection have ever been traced. The lepers, however, are usually kept in on market days, and at Trondhjem at least, and I believe elsewhere, they are not permitted to enter houses and churches, or to come in close contact with other people.

Leprosy in Great Britain and Ireland.

Cases in London.—Within the last two years I have had the opportunity of seeing four cases of leprosy in London. One was a patient of Dr. Ryan of Colchester, a lady, who came up for consultation with Mr. Waren Tay. She was born in England, but had lived with her husband for some years recently in Bombay. She was thickly covered with the nodules of dermal leprosy. Since her arrival home from India she had given birth to a healthy baby. Dr. Ryan informs me that she has been getting worse, but that the baby is still healthy.

Another case, a youth, F. H., aged eighteen years, well educated, came to the Hospital for Diseases of the Skin, Blackfriars, on May 8th, 1888, having just arrived from Barbadoes. His expression of countenance was leonine, and there were nodular thickenings on all extremities, with anæsthesia and some ulceration. A diffuse, irregular, dark pigmentation was

* This term, however, has long been in use for cases exhibiting mutilation of the extremities.

ATROPHIC (SO-CALLED "ANÆSTHETIC") LEPROSY.

Case of E. Y., exhibited at the Epidemiological Society, May 8th, 1883.

UNDER THE CARE OF MR. LARDER, AT THE WHITECHAPEL INFIRMARY.

parts of the body and limbs. He was father being an Englishman, who died of his mother a native of the West Indies, but not coloured, who is living and healthy. When three months old he had been taken to Trinidad, where he remained until fourteen years of age, when he came to Europe for a year. The disease began in Trinidad when he was twelve or thirteen; it got worse while he was in Europe. He then returned to the West Indies, to Barbadoes, and the disease has steadily progressed ever since. He has always lived well, has no recollection of ever coming in contact with anyone with a similar complaint, and can give no information with regard to where he was vaccinated in infancy.

Cases Exhibited.—The remaining two cases are those which, by the kindness of Mr. Larder, medical superintendent of the Whitechapel Infirmary, I am able to exhibit to the Society to-night. They may be regarded as fairly typical examples of the two chief varieties of the disease.

E. Y., aged sixty-four, a meat salesman, born in London, parents never out of England. He was formerly a sailor, and as a young man has been on voyages in the Mediterranean and in the Baltic, but this was upwards of forty years ago. Since then he has not once been out of England, and is not aware of ever having seen anyone with a disease like his. Until six years ago he always enjoyed the best possible health. He exhibits anæsthetic patches on the legs and arms, complete anæsthesia of the legs below the knees, and of the forearms and hands, with muscular and osseous atrophy and superficial and deep ulcerations. The conjunctiva in one eye is becoming the seat of inflammatory deposit and ulceration —no doubt as a sequela of a well-marked paralysis of the right orbicularis muscle; and there is an irregular, dark pigmentation on the neck.

I cannot admit that we have here a case of *de novo* development of the disease, but the interval of time between the man's presence in leprous countries and the manifestation of the symptoms certainly is extraordinarily long. No such "period of incubation" has ever been recorded. The bacillus must have been asleep for nearly forty years, the germ dormant, like the "mummy" wheat.* M. Besnier's

* The diagnosis of this case was accepted at meetings of this Society, May 8th and June 12th, upon both of which occasions the patient was inspected by a considerable number of the members and others, some of whom had been, more or less recently, connected with leper hospitals in the East. The man was formerly, in 1887, under treatment at St. Bartholomew's Hospital, London, where there seems to have been no question as to his being anything but an example of

theory,* which supposes the incubatory stage of the disease to commence only when the latent spore shall have found the soil and other conditions suitable for its culture and proper development, appears to me to be applicable in such cases.

The last case is that of H. S., aged seventeen years, born in Barbadoes, of English parentage. When eight years old he was brought to England, and the disease did not commence until he was between eleven and twelve. His father, a clerk, died in Barbadoes of "fever and ague"; his mother and two brothers are living and quite healthy, and no other members of the family are affected. He does not remember being in contact with or seeing anything of the kind. He believes he was vaccinated after he came to England, "but it did not take".

The poor boy is quite blind, and he shows the discoloration and diffuse thickening of the skin over the face which are generally so well marked in this kind of leprosy. His hands and feet are also affected. Ulceration of the mucous membrane of the mouth and larynx has been progressing, and the cicatrisation of the lips is causing a remarkable and increasing stenosis of the oral aperture. He is now quite unable to put out his tongue.

A few days ago I gently scraped with the handle of a scalpel some of the saliva from the surface of the sore tongue, as well as from the ulcerated lips. Plenty of the typical bacilli are present. (Slides shown on the table.)

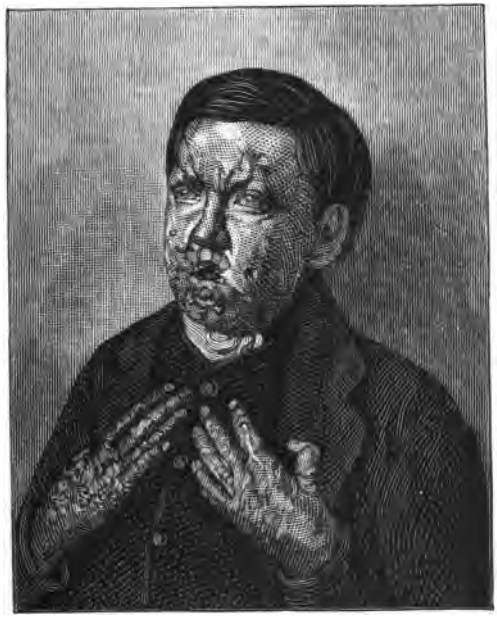
Nomenclature of Varieties.—This is a fair example of the so-called "tubercular", "tuberculous", or "tuberculated" leprosy, and to my mind it well illustrates the inaccuracy of these terms. That it has nothing to do with "tubercle" in a pathological sense nobody pretends, and that there are no "tubercles" in a physical sense is sufficiently obvious.

Dr. Zambaco, of Constantinople,† proposes that this form should be called "exudative" or "neoplastic" leprosy, and that the other chief variety, now commonly known as "anæsthetic" leprosy, should be termed "Danielssen's disease", from the distinguished veteran Norwegian physician who first and so well described it. The faulty nomenclature in vogue was

"Anæsthetic Leprosy". It is right, however, to state that some doubt has been lately expressed as to his being really a case of leprosy, and not one of "Raynaud's Disease". He was, therefore, exhibited by Mr. Larder at the Dermatological Society of London, on July 10th; and was again generally admitted by those present to be a leper.—P. S. A., July 31st, 1889.

* *Sur la Lèpre*, Paris, 1887, p. 20.

† *Mém. sur la Lèpre*, Paris, 1887, p. 1.



NODULAR DERMAL (SO-CALLED "TUBERCULAR") LEPROSY.

Case of H. S., exhibited at the Epidemiological Society, May 6th, 1889.

UNDER MR. LARDER'S CARE AT THE WHITECHAPEL INFIRMARY.

recognised in 1867 by the committee of the Royal College of Physicians, who suggested* that the varieties be named "tuberculated" and "non-tuberculated".

Most pathologists will, I believe, now admit that in the former, characteristic granulomatous dermal nodules and thickenings, teeming with bacilli, are the most obvious phenomena in the well-developed disease; while in the latter, similar bacillary-neoplastic invasions, localised or diffused, are always found in connection with nerve-trunks, which undergo greater or less degeneration, leading to the peripheral lesions characterising the variety.

That the distinction of leprosy into separate forms is really artificial the so-called "mixed" cases testify, as well as those in which the manifestations at first simulate the one, and afterwards the other, accepted variety of leprosy. As has been often pointed out, the "dermal" cases always, at some time or other, present anæsthesia, although, throughout the course of the disease, perhaps not so prominently as when the nerve-trunks are early affected. At the same time, I must admit that there are usually in these latter cases changes in the skin, but chiefly of atrophic rather than of neoplastic nature.

Leprosy in Paris and in London.

As M. Le Roy de Méricourt† remarks, if M. Besnier's statement‡ be correct, that there are probably a hundred lepers in Paris who have contracted the disease in leper countries,§ we ought to have a great many more in these islands, considering our vast colonial and Indian empire and our peregrinating proclivities.

The number of persons afflicted with leprosy who come to England is nevertheless, as has been shown in a recent article,‖ a very small one. Of the poorer classes, it is likely that more have presented themselves at the London Hospital than in any other institution, and even there it seems that the physicians and surgeons have only had under their care five cases, three men and two women, within the last ten years.¶ Two of the men were born in India, of British

* *Report*, 1867, p. lxiv.

† *La Lèpre*, Paris, 1887, p. 10.

‡ E. Besnier, *Sur la Lèpre*, Paris, 1877.

§ M. Wickham, Interne of the Hôpital Saint-Louis, informed me, a few weeks ago, that there are generally six or eight cases of leprosy in that hospital. At the present time there are six, five being male natives of Haiti, Martinique, Brazil, or Guiana, and the last a French soldier who contracted the disease in Guiana.

‖ *British Medical Journal*, March 30, 1889.

¶ I have to thank Mr. Jonathan Hutchinson, jun., and Mr. H. Felkin for this information.

parents; one of the women, a German from Hamburg, had been twenty-seven years a hospital nurse in Calcutta; the other, of English descent, had spent most of her life in the North-west Provinces.

In illustration of the comparative rarity of cases in this country, I may say that I have reason to believe that in the whole course of their long and extensive dermatological practices, not fifty leprous patients have been seen in England, in private and in hospital, either by Dr. Robert Liveing or by Mr. Jonathan Hutchinson; and there is no doubt that the majority of cases which have come to light, during many years past, in London, have been under the care of these gentlemen.

One would imagine that sailors might occasionally bring the disease to this country. Mr. W. Johnson Smith has, however, kindly informed me that there has been only one case of leprosy at the Seamen's Hospital at Greenwich for many years since his connection with the institution.

Leprosy in the Army and Navy.—If leprosy were readily acquired, we might also expect to find cases among our British soldiers and sailors who have served in the Army and Navy in India, Egypt, and the colonies. Fortunately, however, I am able to state—through the courtesy of Sir Thomas Crawford, K.C.B., Director-General A.M.D., and of Dr. Dick, C.B., Director-General of the Naval Medical Department—that there is very little evidence of leprosy in the two services. The only case of leprosy in the records of the A.M.D., kindly pointed out to me by Brigade-Surgeon Nash, M.D., is that of W. J. R., a trumpeter R.A., who, at the age of twenty-three, on account of the disease, had to leave the service in February 1887. He was born in Madras, father an Irishman, mother a native, and enlisted in Dublin at the age of thirteen. He afterwards went with his regiment to India in 1879. Three years later he began to suffer from febrile attacks, accompanied by an erythematous rash leaving a dusky discoloration. The nature of the disease was not suspected or diagnosed until 1886, when he was admitted to hospital. The disease was of the dermal type.

Surgeon-General Sir Thomas Longmore, Professor of Surgery at Netley, has been good enough to inform me that "only one case of leprosy in a soldier has passed through Netley", and this was reported in the *Transactions* of the Clinical Society of London, vol. xiii, 1880. He is of impression—but is not sure—that if cases were observed in the English troops in India, they would probably be retained, and not sent home with other invalid soldiers. In his experience at Trinidad no

European soldier ever caught the disease. He has recently heard of a painful instance of an Army medical officer contracting it in India.

Director-General Dick says, "I have had the records here examined, but not a single case of leprosy among the officers or men of the Navy can be traced in the office."

M. Le Roy de Méricourt, late Principal Medical Officer of the French Marine, records* a similar experience for the French naval service, and he further states that Dr. Van Leent makes the same affirmation with regard to the Dutch soldiers, sailors, and civil servants who have been in Surinam and the East Indies.

It must be remembered that European soldiers and sailors on Indian and colonial service are not likely to be in prolonged and close contact with unhealthy natives. They are, moreover, well looked after and well fed, and cleanliness and hygienic measures are more or less rigorously enforced. These remarks are particularly applicable to the Navy, which, as we have seen, has a clean bill of health with regard to the disease.

Another point, too: although leprosy may not be suspected while a man is in the service, it may make its appearance after he has left.

The leper now in Dublin, under the care of Dr. O'Carroll,† is an old soldier, who undoubtedly contracted the disease while in the Army.

I have tried to find the number of deaths recorded from leprosy in Great Britain and Ireland during the last ten years. I am informed by the Statistical Superintendent at Somerset House that since 1881 any deaths which may be attributed to leprosy would be included under the heading "Other and Undefined Diseases of the Integumentary System". The disease, however, is not even alluded to in the Registrar-General's Annual Reports.

CONCLUSION.—In this paper I have attempted to give a *résumé*, and I fear a very imperfect one, of the latest information to hand in reference to the existence of leprosy, particularly in the British Empire. There appears to be little doubt that the disease is really spreading in South Africa, that it is slightly increasing in the West Indies, and that it certainly is not decreasing in India. It is also beyond all question that Europeans, who sojourn in the affected countries, are occasionally liable to contract the disease.

* *La Lèpre*, p. 10.
† *Trans. R. Acad. Med. Ireland*, 1889.

Our colonies are naturally alarmed at its terrible growth in Hawaii; and, as we have seen, laws for the compulsory isolation of lepers are being talked of, or are already passed, in several places.

1. Is leprosy caused by the bacillus?

This is found in all leprous deposit, but, according to most observers, we cannot, readily at any rate, cultivate it or inoculate it into other animals.*

2. Is the disease communicable from person to person? Twenty years ago the highest medical authority in England practically answered "No". At the present time, the wave of medical opinion is on the uprise in favour of its communicability.

3. Is segregation justifiable? This has been partially adopted in Norway; and, as it did in olden times, it has well succeeded in checking the course of the scourge; also in Canada; but it has so far failed in the Sandwich Islands.

All these are large and important questions, and, had time allowed, I should have endeavoured to adduce arguments in more or less affirmative support of each of them.†

APPENDIX.

I.

LEPROSY IN BOMBAY.

(*Times of India, April* 12, 1889.)

"At a meeting of the Bombay Municipal Corporation, on the 4th inst., an important debate took place on a notice of motion by Mr. T. B. Kirkham, calling attention to the defective regulations with reference to persons affected with leprosy in Bombay, and requesting the Municipal Commissioner to report what additional powers, if any, were required by the Health Department to enable it to deal effectively with the evil.

"Mr. Kirkham, addressing the Corporation in support of the motion, said that, if he simply mentioned the circumstances

* Dr. Wynne of Robben Island is reported recently to have succeeded, and so have a few other observers: further confirmation, however, is needed. Even Dr. Arning's inoculation of the Hawaiian convict is not universally accepted as conclusive.

† Under the microscopes on the table are specimens which I have prepared of the *Bacillus leprœ* from the mouth of the boy H. S., and from nodules or ulcers from Mr. Tay's cases; also a large number of sections of dermal nodules, anæsthetic skin, nerves, and of some internal viscera from other leprous cases.

which had drawn his attention to this subject, the Corporation would readily accede to his proposition, asking the Commissioner to inform the Corporation whether the existing Municipal Act gave to the Health Department of the Municipality adequate powers for the regulation in Bombay of persons affected with leprosy. A few weeks ago, in the discharge of his official duties, he had occasion to visit the Elphinstone High School and the St. Xavier's College, both large educational institutions, and he found, to his astonishment, that for some weeks, or some months rather, a colony of lepers had taken up their abode on the flag-stones surrounding the large Nacoda Tank, which lay between the two institutions, and that the authorities of these two institutions, notwithstanding their appeals to the police and to the Health Department, found themselves practically unable to dislodge the people from these places. The Rev. Fr. Meyer, the principal of St. Xavier's College, took him round and pointed out to him these people on the borders of this tank, performing their ablutions in the middle of the day, and he saw them, with his own eyes, dressing their terrible sores, and scratching their terrible ulcers with stones lying about them, and then flinging away those stones covered with ulcerous matter to be picked up by anyone. He asked the Corporation to forgive him for mentioning the repulsive details, because he felt it his duty to tell them to a body which was entrusted by law with the care of the public health. Fr. Meyer told him that he had seen them with his own eyes rubbing their leprous sores on the iron surrounding the Elphinstone High School, and had seen boys let loose from the school a few minutes afterwards sitting on these very railings, occasionally, it might be, with bare feet. Being asked what the police had done in the matter, Fr. Meyer replied that, with every desire to assist, the police had been unable practically to do anything, and that a day or two after these unfortunate men were dislodged from their abode they again came back to the place. In reply to a representation of the principal of the Elphinstone School, Dr. Weir, the Health Officer, said that he sympathised with him, but regretted there was nothing in the Municipal Act that empowered him to interfere in the matter. That was a most extraordinary letter to emanate from the Health Department of a great city to a public official in charge of thousands of boys, informing him that the department was utterly powerless to interfere in the matter. He (Mr. Kirkham) must not be understood to say that this was an improper letter, but he did say that it was an extraordinary letter. He, therefore,

thought it his duty to ask whether it was safe and proper that these people should be allowed to go about and do what they pleased within a few yards of some two thousand young men. He was sure the Corporation would not deem it a satisfactory settlement of the question, even if these poor people, when driven away from the Esplanade, were simply to take refuge in some less-known parts of the town. That would not be dealing with the root of the evil. With these facts before the Corporation, he hoped that they would not let the matter drop without arriving at some sort of satisfactory settlement.

"Dr. Arnott said that he was exceedingly obliged to Mr. Kirkham for coming forward with a resolution which was of so great importance, and which, he hoped, the Corporation would at once accede to. The subject of leprosy had attracted the attention of the profession for a very long time. If there was any authority on the disease, who deserved respectful attention, that was Dr. Carter, and he had over and over again urged the pressing necessity of providing a suitable asylum for lepers, and taking measures to prevent their being a danger to the community. This was a very difficult and a very large subject, and the motion of Mr. Kirkham would enable men to see what could be done by the Municipality, and would have the further effect of calling public attention to the subject. The speaker agreed with Mr. Kirkham on the necessity of taking adequate measures for the segregation of lepers on grounds of public health. But the lepers deserved sympathy, for suffering from an incurable and loathsome disease, they were obliged to leave their homes, and they could not work. Some refuge must be provided for them. At present the only places where they could live were a small dhurumsala at Byculla, a small ward at the Sir Jamsetjee Hospital, and the asylum at Trombay. With these exceptions, there was, in Bombay, no place, no refuge, no asylum where these poor creatures might go and be cared for. Bombay was known for its munificence, and he earnestly hoped that some person as generous as wealthy would provide a suitable asylum for these unfortunate people.

"Dr. Blaney said there was no doubt that leprosy existed to a large extent, not only in Bombay, but in the whole of India, and that as a question of imperial importance it was the duty of the Government of India to deal with it. Mr. Master's amendment, declaring that it was the duty of the city to bear its share in the work of providing for its lepers, was good so far, but he maintained that the evil could be effectually met only by treating it as an

imperial question. He had attended several meetings held for the relief of lepers, and through Dr. Hewlett's exertions some thirty or forty thousand rupees had been subscribed, but the subscriptions had been returned, and nothing came of all these attempts to do something for the unfortunate people. If the community were to do all that humanity demanded, if they were to take the subject in hand properly—and it would only be properly dealt with by being taken up as an imperial question—they could extinguish the evil. His official position as coroner enabled him to say something about leprosy which was known to nobody else. Every year he gave orders for disposing of the dead bodies of 10, 12, or 15 lepers. He did not hold a regular inquest on them, but always made his inquiries; and he found that some of them had died on the road-side, sometimes in front of the Elphinstone College, sometimes at one or other of the wells on the Esplanade. Some of them drowned themselves in these wells, tired of life, neglected by the Government and the Corporation, neglected by Mr. Kirkham, neglected by Mr. Mehta.

"Mr. Kirkham: And neglected by the coroner.

"Dr. Blaney, continuing, said he did not think there was a single well on the Esplanade in which a leper was not drowned. All over Bombay, in dark corners, in gullies, where rats and bandicoots had taken their abode, these lepers were hiding themselves, thrown out by their families, to pine away, neglected and forlorn. He held, some time ago, an inquest at Dongri on the body of a leper. He and his wife were labourers residing on Mr. Jalbhoy's property. The man got afflicted with leprosy, and his wife told him to leave the house. He thereupon went up to the top of the hill, and there he hid himself behind some rocks. The wife daily brought his food to him, but he was tired of his forlorn and pitiful condition, and threw himself over the cliff and killed himself. In Bombay, people had talked a great deal about leprosy, and had promised to do this and that, but nothing had yet been done. The community had a great obligation resting upon them, which they could not neglect. The evil could be eradicated by proper means—it could be done by money, by skill, and by honest work—and it was their bounden duty to stamp it out. Leprosy in Bombay was vastly increasing. Lepers were to be seen in all parts of the city, and not at the Elphinstone School and the St. Xavier's College alone. He would support with all his heart any proposition which would take this matter thoroughly in hand, and therefore he agreed with the suggestion of Mr. Mehta

with reference to Mr. Kirkham's proposition. Let them go to the root of the evil; let them urge upon Government that they were willing to do their share of their duty to the city and to humanity in general, and then alone the evil would be effectually grappled with."

II.

The *Pioneer Mail*, Allahabad, N.W., April 10th, referring to the discussion in the Bombay Corporation (*Times of India*, Bombay, April 12th, 1889), says: "It is impossible to exaggerate the loathing and horror which these revelations are calculated to inspire in the unsuspecting public. We seem to be reading rather of the insanitary foulness of a mediæval city where medical science was still in its infancy, and men's conception of the duties and responsibilities of civic government still rudimentary, than of a state of things in a great city of the nineteenth century British empire. Yet the Commissioner of Bombay had to confess that they were absolutely helpless in the matter, and though appeals have repeatedly been made both to the Health Department and to the police, they, too, have declared their inability to move in the matter. It will be seen that if the Government of India adheres to the position taken up by them in their resolution of October last, the provisions of the new Leper Bill are likely to be wholly inadequate to meet the necessities of the case. The resolution states, that 'for the present, at all events, it is impossible to do more than encourage the grant of medical and charitable relief in voluntary hospitals and leper asylums'; but if this be all that is done, it is clear that the lepers will still be able to dress their hideous sores beside the water-tanks of our great cities; that they will still be found begging alms and spreading possible contagion in the market-places, or gasping out the last sighs of a miserable existence on the road-side. The very first step towards a removal of the evil must be the empowering of the Health Department and the police to compulsorily segregate leprous patients from the general population, even though the methods at first employed should be less strict than the most recent discoveries of medical science demand. But as the Bombay coroner remarked, the evil can only be fully dealt with as an Imperial question, on some such lines as Norway has adopted with such signal success."

Lepers in the Streets.—A Calcutta paper states that the leper nuisance, which seems to fluctuate with the seasons,

becoming more aggressive in the hot weather, is just now very bad in some quarters of the town. (They may be seen haunting the markets and tramway stations, Dalhousie Square, etc.) Sitting huddled in a heap close up to the railings, in the shade, may be seen any day three or four of these lepers in an advanced state of disease. After a sickening description of the appearance of these men, it is stated that there seems to be no remedy for this state of things, or surely it would be promptly applied. The police are helpless, as the lepers, if arrested, would only be warned and released by the magistrates.

III.

Cape of Good Hope.—Act to Check the Spread of Leprosy ("The Leprosy Repression Act, 1884"). *Assented to July 11th*, 1884.

"Whereas the disease of leprosy is prevalent in this colony, and has lately been spreading, and continues to spread, and it is desirable to check the extension of such disease, and, if possible, to exterminate it, be it enacted—

"1. Whenever it shall be certified to the Governor, by the district surgeon of any district, or by any other duly qualified medical practitioner, and by a field-cornet or justice of the peace, that any person is suffering from the disease known as leprosy, and that the fact of such person being at large is likely to spread such disease, the Governor may, by warrant under the hand of the Colonial Secretary or Under Colonial Secretary, order that such person shall be removed to such asylum or hospital as he shall appoint, to be there detained during the Governor's pleasure, and kept apart from contact with all other inmates of such asylum or hospital who are not afflicted with the same disease. Provided always, that every such person, while so detained, shall have the liberty and privilege of seeing his friends and legal advisers at all reasonable times, under such regulations in force for the time being as the Governor may provide in that behalf.

"2. Every asylum or hospital in which males shall be detained under the provisions of this Act shall be separated entirely from any asylum or hospital in which females shall be detained."

(Then follow provisions for maintenance of patients, etc.)

IV.

Copy of Act "to Facilitate the Segregation of Lepers" in the Hawaiian Kingdom.

"Section 1. Whoever shall knowingly detain or harbour upon premises subject to his control, or shall in any manner conceal or secrete, or assist in concealing or secreting, any person afflicted with, or who is suspected of having, leprosy, with the intent that such person be not discovered by or delivered to the Board of Health or its agents, or who shall support or assist in supporting any such person living in concealment, shall be deemed guilty of a misdemeanour, and shall, on conviction thereof before any police or district justice, be liable to a fine of not less than 10 or more than 200 dollars.

"Section 2. It shall be the duty of every police officer or deputy sheriff, knowing of any person within the district where he resides afflicted with, or who is suspected of having, leprosy, to report the same forthwith to the agent of the Board of Health in such district, if any, otherwise to the nearest agent to the Board of Health.

"Section 3. Any police officer or deputy sheriff who shall wilfully fail to comply with the provisions of Section 2 of this Act shall be guilty of a misdemeanour, and upon conviction thereof before any police or district justice shall be fined in a sum not less than 10 nor more than 200 dollars, and shall be dismissed from office.

"Section 4. This Act shall take effect from and after the date of its approval."

This new Act has now the force of law, and H.B.M. Consul-General at Honolulu states, in a despatch to the Foreign Office, dated March 19th, 1889, "that under its provisions 821 lepers have been removed to the leper settlement for segregation from the 17th of July 1887, to the 12th of March 1889."

V.

"Leprosy Committee Report", communicated to the Royal College of Physicians, July 15, 1887.

"The Committee appointed by the College to consider the communication from the Colonial Office on the subject of Leprosy, having given the questions contained in that communication their most careful consideration, now submit their Report to the College.

"The Committee are quite aware that there is much differ-

ence of opinion respecting the communicability of leprosy, and that many Colonial practitioners and inhabitants do not concur in the views expressed by the College in their Report in 1867.

"The Committee are of opinion that if there be any elements of contagion in leprosy, they are not more to be dreaded than are those in the case of syphilis, which is not commonly considered to justify compulsory segregation on the part of those affected.

"The Committee believe that leprosy is not contagious in the conventional sense of the term; but, if at all, is only so in low degree, and under exceptional circumstances.

"The Committee are of opinion that a further investigation into some of the more recondite points respecting the pathology of the disease would confirm or remove any doubt that may remain as to the question of communicability, and they therefore recommend that the Government should institute such an investigation as this College might direct, and report on to the Government when completed.

"Whilst the Committee do not believe compulsory segregation to be justifiable, the encouragement of leper asylums or houses properly regulated they consider most desirable; such asylums not to be regarded as prisons, and so arranged as not to prove foci for intensifying the disease, but as refuges where kindness, care, and enjoyment of the simple, though necessary, conditions of a healthy life would be insured.

"In this direction the Committee strongly recommend State interference and assistance.

"(Signed) C. HANDFIELD JONES,
"*July* 15, 1887. *Chairman.*"

DISCUSSION.

The adjourned meeting, for the purpose of discussing Dr. P. S. Abraham's paper upon Leprosy, was held on Wednesday, June 12th, 1889. The President of the Society, Dr. Thorne Thorne, occupied the chair.

The discussion was opened by the reading of a paper by Surgeon-Major Pringle, on "Leprosy in India", in which he maintained that the disease was vastly increasing in that country. He regarded the disease as highly contagious, demanding compulsory segregation and urgent measures to prevent its dissemination and introduction into England.

Dr. Thompson, who has recently been in charge of the

Madras asylum for lepers, remarked that there was some real risk of the disease becoming prevalent in England, owing to the free intercommunication which existed through the mercantile marine with the natives of India. In his opinion leprosy was undoubtedly contagious, and he agreed with the last speaker as to the necessity for compulsory segregation.

Surgeon-General Sir William Moore observed that there was no increase of leprosy in India. He believed that the disease was contagious, but only through an abraded surface; that leprosy was also inherited; and he was strongly of the opinion that it was only another phase of syphilis. He affirmed that segregation of the lepers in India was an impracticable measure, and that the only means of arresting the prevalence of the disease in India was by the enforcement of sanitary principles.

Mr. Brudenell Carter referred to two cases of leprous English officers, who came under his care suffering from the loss of vision resulting from the disease.

The Rev. Mr. Guilford gave an interesting account of the leper asylum, of which he is now in charge, in the Punjab, and of the difficulty he had experienced in effecting improvements in the state of affairs. He strongly advocated legislation on the subject.

Mr. McClean referred to the frightful condition of the lepers of Madagascar, and the efforts which he and others are making with the view of ameliorating their lot.

Surgeon Blunt, R.N., who had just arrived from the Cape, also made some remarks upon the subject, regarding the increase of leprosy in South Africa.

Mr. Larder described his treatment of the cases shown, which had benefited to some extent with the use of chaulmoogra oil.

The President, before calling upon Dr. Abraham to reply, observed that it was not necessary to take an alarmist view of the situation of affairs in regard to the increase of leprosy. At the same time, however, he held that there was an urgent need for an inquiry as to the natural history of the disease and the measures which should be adopted in order to prevent its dissemination.

Dr. Abraham, in reply, said that he could not go as far as Dr. Pringle in his fear of the spread of the disease in this country. While believing that segregation is advisable, he pointed out that in some cases, as in Iceland, leprosy was practically disappearing without isolation; that in the Sandwich Islands, where segregation has been more or less vigorously enforced for many years, the disease has, nevertheless,

increased; and that in Norway, where it has diminished, the segregation was not absolute, as shown by the curves exhibited. Against the theory of heredity, Dr. Abraham alluded to the facts in a recent paper brought forward by Dr. Blanc, of New Orleans, and the remarkable evidence collected by Dr. Hansen among the descendants of Norwegian lepers in North America. With reference to separation of sexes, he stated that the fear of increase by breeding was not so great, because it is well known that lepers are very sterile in the production of offspring. He spoke of the inoculation attempts which had been made upon animals, and made further remarks upon the subject, which he considered demanded extensive investigation.

The two cases exhibited last time were shown again and described, and a large number of microscopic sections and bacilli were shown by Dr. Abraham.

THE INCREASE OF LEPROSY IN INDIA; ITS CAUSES, PROBABLE CONSEQUENCES, AND REMEDIES.

By SURGEON-MAJOR R. PRINGLE, M.D.Edin. (Retired).

(*Read: June 12th*, 1889.)

For facility of discussion, I have divided this subject into four heads, viz.—1st, The increase of Leprosy in India; 2nd, The causes of this increase; 3rd, The probable consequences of this increase; and 4th, The remedies to check this increase, and ultimately to stamp out the disease.

1st. *The Increase of Leprosy in India.*—Is this increase real or imaginary? If the latter, is it due to the subject having been lately brought more prominently to notice? Till this point is settled it seems useless to even commence this discussion; and when Dr. Abraham states the following, in his paper on this subject, we are met at the outset by a very serious obstacle. "One of the highest medical and statistical authorities in the Indian Government," writes Dr. Abraham, 'has recently stated that he does 'not know of any good ground for believing that leprosy is increasing in India, or that it is diminishing';" and again, Drs. Lewis and Cunningham, of the Indian Sanitary Department, with reference to the increase or not of leprosy in the Kumaon District of the Himalayas, state: "Any risk of rapid increase in Kumaon is not to be apprehended"; and yet the Hon. Sir H. Ramsay, the Commissioner of Kumaon in 1875—I still quote from Dr. Abraham's paper—writes: "It appears to be wrong that this fearful disease should be allowed to continue to spread itself among the population, if any means can be taken to prevent it." The question may well be asked, who is right? I unhesitatingly state Sir Henry Ramsay is; and now that I know the opinion of the Sanitary Authorities on the subject, in their capacity as medical advisers to the Government of India, I certainly exculpate that Government from the charge either of apathy, or indifference, in the matter; the whole being in entire keeping with the action of the Sanitary Department for the twenty years dating from 1864, the period of my service in that department. It was so with the deadly

malarial fever which swept over the Garden of India, the upper portion of the Mesopotamia of the Ganges and Jumnah, and was the product of inundation, falsely called irrigation. It was so with the cholera at Kurdwar in 1867 and 1879. It is so *now* with the disgraceful conditions of the water-supply, visible in the sad increase of typhoid fever. I know these are grave charges, but I am prepared to support every one of them, on the evidence of my public reports; while the climax was reached in the N.W. Provinces and Oudh, in 1883, by a system of vaccination, carried on for years in some circles, which left it, so states a Government Report, "impossible to say to what extent the population of the circle (about 17,000,000) has been protected against small-pox."

For years I have noticed this increase of leprosy, and, when I saw the benefits of the Leper Asylum at Dehra, urged on the authorities the importance of supporting that institution and establishing others; but all in vain, *not the very least notice was taken of my appeals.* And if I write strongly, it is because I feel strongly the terrible injury which has been inflicted on the health of my late sanitary circle, by the marked indifference with which the Leper Asylum at Dehra, in the N.W. Provinces of India, was viewed.

2nd. *The Causes of this Increase.*—First and foremost the fact that lepers are *now* not *removed* in various ways, as they used to be. This preservation of leper life has been going on, more or less, since the great order: "Burn not widows, kill not infant girls, bury not (alive) lepers", was promulgated in the Punjaub, after its annexation; but in the utter neglect of any precautionary measures against this increase, and consequent spread of leprosy by the protection afforded to these lepers, we now see the natural sequence of an order, which, though very creditable to the philanthropy of the rulers, was very discreditable to the sanitary knowledge of their medical advisers. The order, though promulgated many years ago, has, I believe, not been rigidly carried out till *very lately;* the fact being, that in many parts of the country it was possible to remove lepers, not only with facility, but with perfect secrecy, and this not among the poor and lower, but also among the richer and upper, classes, owing to the following circumstances. All who have studied the manners and customs of the peoples of India must have noticed how closely religion is mixed with, indeed is the mainspring of many of, those customs which have the most important bearing on the social, political, and even agricultural welfare of the people of this land. The mode, therefore, of preventing the probable increase, and consequent spread of, leprosy, formed no excep-

tion to this rule, and was not only dictated by religion, but the manner of carrying it out, in the Himalayas at least, viz., of pushing the poor lepers over precipices into the stream beneath, had a charitable aim in view, viz., the hope, that in time, the particles of the poor sufferer would ultimately find their way by water into the all-purifying stream of "Mother Ganges", in which there was, even for the leper, a hope of cleansing, and thus of rest and happiness hereafter. The removal, therefore, of the leper by this method was both socially merciful and religiously kind, and was thus also sheltered under the seal of social and religious secrecy.

The highest caste is lost by the slightest sign of the leper *spot*, and then "they of his own house" at once become the leper's foes, not only to wipe out the disgrace of the leper-taint in the family, but in the hope of doing all that lies in their power to secure for their *out-casted* relative that hope that the sacred waters of the Ganges alone can grant. Thus it was that from these foes in their homes, with a strange tenacity to life, the leper fled homeless, friendless, religion-less, with the constant, indeed ever present, dread of a violent death lurking around, unprotected even by the brand of Cain the murderer, and the fear of punishment from Cain's Divine avenger. We are told there are fewer female than male lepers. This is easily accounted for; because among the males there is a community, not only in the sympathy of suffering, but also in the fact of mutual protection. With woman it is different; in many parts of India it seems almost meritorious to *remove* her, and in that land of secret murder, where cholera and snake-bite, wild beasts and rapid decomposition, unite to facilitate this removal, and obliterate the traces of the methods adopted to accomplish this end, one ceases to wonder how, judging from analogy, the comparative number of female lepers is so small. Dead men tell no tales, but burnt, eaten, or rapidly decomposed bodies tell fewer; while in many districts a practice of systematic secret poisoning with drugs, as little known as capable of detection, when combined with the aid afforded by making the removal of a leper a religious, nay charitable, act, have till very lately resulted in conditions which have most effectually checked any marked increase of leprosy in the Himalayas, where the population is, comparatively speaking, very limited. But *now* the life of a poor, homeless, friendless, religionless leper is on a par with that of the high priest of Budrinauth, or the sacred hereditary sweeper of the idol of Juggernauth, the Rajah of Khoordah in Orissa; and perhaps nothing illustrated the value of human life under the *pax Britannica* more powerfully to the Hindus of India than the

manifestation of the powers which enabled the far-reaching hands of the law to take out the manslayer, even from the precincts of the temple of Juggernauth, and depose to perpetual banishment the hereditary superintendent of that universally worshipped shrine, for, in a fit of anger, being the cause of the death of a poor sweeper! Thus *it is not now safe to run over a leper*, and in that land of vindictiveness, summed up in the word *zid*, spite, the risks are too great even to attempt it, and therefore the lepers live, and are increasing rapidly.

It may almost seem as if I had dwelt too long on this point of this subject, but it is from twenty years of the closest study of this aspect of it that I have come to the conclusion that, had it not been for these means of removing lepers, and the absence of means of segregation and isolation, with the certainty of a more painful death awaiting them in the plains of Hindustan, and one which had nothing purifying in it—viz., burying alive—if they got away from their native mountains, and that had it not been for the limited population of the Himalayas, the poverty of the vast majority of its people—visible in some districts in the practice of polyandria, as polygamy is of wealth in others—with, at times, seasons of famine prevalence, and an utter ignoring of sanitation, leading often to outbreaks of typhoid, nay, typhus, and, as I have known in 1864, actual bubonic plague, the population would not only have gravely deteriorated, but would have diminished to a point where the wild beasts would have dominated, cultivation decreased, and ultimate famine and want have depopulated these beautiful valleys. None can have wandered among these mountains, as I have done, without often coming across what once must have been large villages, now only a heap of stones hidden in a jungle of gigantic nettles: the cause too often being sickness, debility, consequent inability to cultivate from limited population, alarming mortality, flight of survivors, and desertion of the old village; and all this, be it remembered, has taken place without any of it being chargeable to leprosy, which brings me to the third portion of my paper.

3rd. *Probable Consequences of this Increase of Leprosy.*—First of all, this increase will not for many years yet affect the population of these mountains; but it will, therefore, all the more rapidly and surely affect the population of the plains, for the following reasons. Our law may forbid the *removal* of the leper, but it will not keep him or her in the house, village, or caste; so the man goes to work in the plains of Hindustan, and the woman to gain a livelihood by a

mode of life which she knows can only last for but a short time, viz., till the voice, in unmistakable tones, cries, "Leper, leper!" and this life will be led most probably around European military cantonments. How the seeds of the disease may be disseminated by both males and females of these poor afflicted ones, ere this stage of utter-out-caste-existence has been reached, the two cases before us will show, while the specimens of the saliva, discharges, and exudations under the microscope, will bring this home in a manner not soon to be forgotten. There is, however, one mode of dissemination of this loathsome disease which neither of these cases illustrates, nor yet any of the microscopic preparations around us, and that is the subtle risk apparently inseparable from the military occupation of the country by European, and, indeed, by native troops. I was in hopes of being able to illustrate this sad phase of the subject by bringing before you a young man in the prime of life (whom I must have known at the Government Engineering College at Roorkie, N.W.P., in 1879), now fighting, with an otherwise splendid constitution, a hopeless struggle against this secret, invincible, loathsome foe; but I have lost all trace of him, and either the disease has proved rapidly fatal, or else, *in the absence in this country of any home of peace and comfort*, an existence which had little in itself to make it desirous to prolong has been prematurely cut short.

What, therefore, will be the probable consequences of this increase of leprosy in India, as regards the British occupation of that country from a military point of view? and what the bearing this must have on the future public health of this country?

Without in any way indulging in what some may think needless, others groundless, alarms, I feel it to be my duty, as an army medical officer, with very considerable sanitary experience of the subject, to state distinctly, that the probable consequences of the conditions I have described are very serious as regards the health of the British soldiers in India; and, judging by the analogy supplied by the after-effects witnessed in this country, from the very limited residence and intercourse of the troops with the peoples of the East in the time of the Crusades, still more serious to the public health of this country, on the discharge of the soldier from the army, and his re-entering civil life. The exemption noted in the past, must not be taken as any guarantee for the future, as the *removal* of lepers in the past certainly did keep down their numbers; but whatever the risk might have been under the old long service system of the Royal Army, or the

long military service and residence of the late H.E.I.C., all is now indefinitely increased under the present short service system, with such a small percentage of married men in the ranks; and on this account alone, if on no other, I consider that the situation demands the most serious attention of the authorities, with the view, as far as practicable, of limiting the possibility of the mode of dissemination of the disease under notice, by scientific and rigid segregation, and isolation of these cases in the *early stages of the disease*, when their very possibility of concealment adds infinitely to the subtlety of the risks incurred. In support of my observation regarding the probable increase of lepers around the military cantonments in the Himalayas, where the troops are sent to recruit their health, I may state I heard only to-day (June 12th, 1889), from a senior officer, late of the Quarter-master General's Department, who had just returned from India, and who is specially qualified, from his service on military sanitary committees, to give an opinion on the matter, that, unless taken in hand at once, this increase of lepers may lead to disastrous consequences.

It is impossible to consider the cases we have had before us without being struck by the remarkable resemblance between some of the external symptoms they exhibit and those met with in the ultimate characteristic lesions of constitutional syphilis; and all must feel that there is some terrible analogy between the two diseases, confined not only to some of the symptoms they exhibit, but extending also to a similarity in the modes of their dissemination.

As regards the possibility of inoculation with the virus of leprosy, or the chances of acquiring the disease through contagion or infection, we have only again to think of the cases we have just seen, and the preparations under the numerous microscopes, to satisfy ourselves that, if these poor creatures are allowed to mix at will with the community, the risks the public will run must be great.

To those who have made the subject of the infection and contagion of the eruptive exanthemata a matter of study, the dangers of the situation will be most apparent; and having, during my thirty years' Indian service, made the modes of infection and contagion in small-pox, inoculation, and vaccination, a matter of the closest investigation, I would desire to point out the following as the probable consequences of this increase of leprosy, believing, as I do, the disease under *favourable conditions* to be inoculable, as was well illustrated in the case of the late Father Damien, whose mode of life, however, *specially favoured inoculation*, and greatly reduced

the power of resistance to the malady, hence the cause perhaps of the disease in his case proving fatal before it had reached the terrible condition, so frequently met with in India, when death, not life, seems present before you! Without entering into the details of what appears to me the analogy between the mode of infection and contagion with small-pox virus, and what may probably be expected to result, if leprosy becomes more general, and segregation and isolation are not practised, I would only remark that one of the most potent, but terribly insidious, nay, secret means of spreading the disease by inoculation would be by flies! No one who has had any experience of leprosy in India, and seen the poor creatures who visit the sacred shrines of Juggernauth, etc., but must have noticed the mass of maggots *invariably* found in the leprous sores of these poor creatures when they have been long undressed (which nothing but powdered charcoal poultices, well moistened with turpentine, can remove); and when we think of the highly contagious character of the feet of the flies that deposited the eggs from which these maggots came, and know that in India the skin is often irritated from various causes, leading to scratching and consequent frequent abrasions of the skin, we shall cease to wonder why leprosy must increase when no steps are taken to protect the public health.

4th. *The Remedies for the Increase of Leprosy.*—These are three—(*a*) segregation, (*b*) isolation, and (*c*) separation of the sexes.

(*a*) *Segregation.*—Here, I am thankful to say, I have no need to *recommend* any remedy, but to *point* to one which has acted admirably in every way during the decade of its existence ending last year. I allude to the Leper Asylum at Dehra Dhoon in the N.W. Province of India, under the superintendence of Surgeon-Major G. MacLaren, M.D. Whether we view this asylum from a scientific, philanthropic, economic, or effective point of view, in my opinion, and I have had considerable experience on the subject, it stands out prominently as the first institution of its kind in superiority, and, if viewed from a purely economic or effective aspect, as one capable of the most extended imitation. If the triumph has *now* been achieved, and the Government of the province pay one-third of the expenses, viz., Rs. 1,500 a year, I know how it has struggled on year after year, and how nobly one, now gone, the late Mr. Wilson, but best known as "Shikari Wilson", helped it with a large invested sum, yielding a fair annual income; but for this the building would have

crumbled to ruins, and the inmates been scattered over the country. Then who would have been to blame?

Year after year, as Sanitary Officer of the Circle, I pleaded for this asylum, seeing the probability of its complete collapse, but all in vain! And now that I know the late Sanitary Adviser to the Government of India was under the impression that leprosy had not increased, I repeat I entirely exculpate the Government of India, and throw the whole blame of this neglect on a department which, to my certain knowledge, during the twenty years from 1864, by its apathy and indifference, has been the cause of an amount of misery in the Garden of India, the upper portion of the Mesopotamia of the Ganges and Jumnah, which it is impossible to depict. I fear, too, that there is more misery in store for this portion of India, from the extension—with the knowledge, I presume, of this Sanitary Department—of an unscientific system of inundation, falsely called irrigation, in the Mesopotamia of the Hindau and the Kalla Nuddee, where the poor people never wanted it, and begged to be spared the misery they saw around them! If I write strongly, it is because I know what Surgeon-Major MacLaren has done for this noble leper institution; but in the Sanitary Department of India, so truly described by the late Professor de Chaumont as one ruled by the dictum of "Aut Cæsar aut nihil", it was hard upon a junior officer to do more than Dr. MacLaren did.

Dr. MacLaren's last report, that for 1888, is like everything else connected with this asylum, a model of brevity and perspicuity, and I offer no apology for making an extract or two from it. Alluding to the benefits conferred by this asylum on the community by scientifically and mercifully checking the spread and increase of leprosy, Dr. MacLaren states: "Thus, then, this small institution has prevented a probable increase of nearly 100 lepers during the past ten years, by segregation, isolation, and separation of the sexes"; and justifiably might Dr. MacLaren write: "Now, if there were, throughout India, 1,000 such institutions, conducted on the lines of this one—strict segregation of the sexes, and comfortable, healthy surroundings—a probable increase of lepers to the extent of 7,000 or 9,000 annually would be prevented; and with improved dwellings and modes of living, the disease might eventually become as rare as it is in European countries. As no remedy for leprosy has yet been found, segregation of the sexes is the only method which holds out any prospect of being able to cope with the disease"; and yet this valuable practical knowledge and experience were nearly lost,

by this asylum crumbling to ruins and its inmates being scattered, through the culpable neglect of a department designed to protect the country from preventable diseases. Comment on this is needless.

This asylum enables the municipality of Mussoorie, a large hill-sanatorium in the Himalayas, to rigidly carry out the rules forbidding lepers to sit by the roadside, even though they cannot be charged with begging. As a member of this municipality, when the subject was brought up, I protested against the enforcement of the rules, unless some satisfactory arrangements were made for the proper reception and support of these afflicted creatures; and this was done by the Leper Asylum at Dehra, but not before it was needed, as is shown by a sad case which came to my knowledge of a poor lady, journeying to Mussoorie, in delicate health, receiving such a shock from suddenly, and quite unexpectedly, seeing one of these poor creatures, that the consequences were most distressing.

What has been done at Dehra can be done in any portion of India afflicted with many lepers; and if the poor Dehra Dhoon, which has to import much of its grain-supply, can help in keeping up an asylum like this, any district in India should be able to do so, if the scheme is properly set about; and the municipality *will* help, when convinced of the need of such measures to protect their own families from this disease.

(*b*) *Isolation.*—This must be complete and permanent, and those who know the lepers best feel confident that, if treated as they are at the Dehra Asylum, they will gladly accept the shelter, rest, and peace; while those who want to leave, and object to this isolation, are mostly comparatively young, who, as yet, are but little disfigured, being thus, in my opinion, the most dangerous class of lepers to the public health, especially the women, for reasons given before. I have never visited this asylum but I have been struck with the contented and happy look of these poor sufferers—a rich reward to those who have laboured for them. To draw a comparison: not fifty miles from this modern leper asylum are to be seen lepers living in relations to the general community which are a disgrace to any municipality, and infinitely more so to a wealthy one like that of Saharanpur; but then, alas, the authorities "care for none of these things"—a sadly infectious condition for any ruling power to be in, as it is sure to develop its like among their subordinates.

(*c*) *Separation of the Sexes.*—Any asylum used for lepers, which does not strictly carry out this principle, *should at once*

be closed, and careful arrangements made to close, innocuously to the health of the general public, the lives of the leprous beings thus produced and left in the world. How philanthropy could take this line of showing pity to the leper is to me inexplicable!

To sum up what has been said, I may state that what is wanted for India, under the head of remedies, is a careful inquiry into the principles on which the various leper asylums are conducted, and they should all be divided into three classes.

Class A. Those which are entirely deserving of support, such, for instance, as the Dehra Dhoon Asylum.

Class B. Those capable of improvement, and consequent support, such as the Umritsur Asylum.

Class C. Those so utterly bad as to *demand* immediate closure, and the taking of steps to protect the community from the evil effects of the product of these *leper nurseries!*

In conclusion, I would only state that I have purposely omitted all allusion to treatment. There is no curative treatment for leprosy, as I have had ample opportunities at Juggernauth and Cuttack of proving, but there are abundant means and scope for ameliorative treatment, in a liberal diet, oleaginous anointings, and the internal administration of *chalmoogra* oil, the two latter having a remarkable effect in soothing the distressing symptoms which prevent sleep. This sleeplessness of leprosy, and the consequent restlessness it induces, is one of its most trying symptoms.

Since the cards of invitation which have called us together were issued, a most important telegram has been published in *The Times* of the 7th June 1889, dated Simla, the 6th June. By this it will be seen that the Government of India have been aroused to the sense of the critical nature of the situation, not only as it affects the people of India and their troops, European and native, but also the health of all the nations having intimate relations with that country; and the Indian Government, not unnaturally, has no wish to be called the propagator of leprosy, as it was lately viewed as the originator and disseminator of cholera. All interested in the welfare of the lepers will rejoice at the action of the Government of India, but I trust the police action will be withheld till suitable accommodation and support shall have been provided for these poor lepers, else their lives will be made more miserable than ever, and numbers will be led to

commit suicide! The native opinion of a leper at present is, that he is one who *should be removed,* and thus, to hand them over to the tender mercies of the native police under these conditions would be a refinement of cruelty.

POSTSCRIPT.

Since this paper was read, owing to the prominence given to the consideration of this increase of leprosy by the action of the public press in the matter, and more recently by the remarks of His Royal Highness the Prince of Wales at the opening meeting of the Committee of the Father Damien Memorial Fund at Marlborough House in June 1889, the opponents of vaccination have brought the subject to the front on their own lines, with the apparently authoritative statement that this increase of leprosy in some countries, notably some of the West India Islands, is due to the prevalence of vaccination, and to its enforcement by compulsory enactments.

In support of this statement several medical authorities are named, whose knowledge of the subject had been acquired from the practice of their profession in several of the West India Islands, and it is therefore undoubtedly deserving of the greatest attention. But what concerns me most is the specially recorded statement by a Dr. B. J. Bechtinger, who seems to have made leprosy the subject of special investigation in the East and West Indies, in South America, and the Sandwich Islands, and who, writing so lately as January 1889, distinctly states that he considers the serious increase of the disease (leprosy) to be "largely due" to its spread at the point of the lancet in vaccination.

Now I know nothing about the West Indies, or South America, or the Sandwich Islands, but I think I know as much about leprosy in the Himalayas (where this disease is gravely endemic), and about inoculation and vaccination in these regions, as any medical officer in the Indian Army, either past or present, and I most distinctly and positively state that, with reference to this admitted increase of leprosy, it is in no way traceable to the arm-to-arm vaccination practised in these mountains since 1864, either as regards its causes, probable consequences, or remedies; and I am prepared to support this statement before any properly constituted Commission from the continuous experience of twenty years, in a circle with a population of ten millions, crowded

together to the extent of over five hundred to the square mile.

I offer no apology for adding this expression of my opinion on the subject of the increase of leprosy in India, and I am glad to have the opportunity of doing it thus publicly, for the evidence of so many of the medical officers of the West India Islands to the very opposite effect is not to be lightly set aside, but, in my opinion, should be carefully inquired into—indeed, demands a most searching investigation.

SIR WILLIAM R. E. SMART, M.D., K.C.B., K.L.H.,

Medical Inspector-General, R.N., Hon. Physician to the Queen.

In the death of Sir William Smart the Epidemiological Society has had to deplore the loss of an eminent member, distinguished alike by his professional and his official position and high personal character, who had for many years taken an active interest in our proceedings, by frequent attendance at the meetings and debates, and by contributing several valuable papers to the *Transactions*. He became a member in 1857, and was elected President in 1873, performing for two years the duties of the office with the ability, tact, and courtesy that were his characteristics. His communications, written and oral, based on his practical experience of disease in various and distant regions, were conspicuous for lucidity of style and accuracy in stating facts and figures, for he combined the qualities of an acute and careful clinical observer with those of an accomplished statistician. He found in this Society congenial fellow-workers, took great delight in their discussions, and devoted much time and talent to impart to them the fruit of his knowledge accumulated in his long naval career. It is therefore fitting that some account of his life and labours should be placed on record.

Sir William Smart acquired his love for the Naval Service at Devonport, his native town, where he obtained the early part of his medical education as pupil of a local practitioner, of whom he often spoke with gratitude for much valuable instruction, and he considered such training to be highly advantageous. In London he prosecuted his studies at St. Bartholomew's Hospital and the Aldersgate School, and in 1839 received the diplomas of Surgeon and Apothecary. After a brief experience of private practice he entered the Royal Navy in 1841, his first service being on the *Cruiser*, in the first Chinese war. He was next appointed to the *Sappho*, on the Cape of Good Hope station and Mozambique Channel, employed in the suppression of the slave trade. Subsequently he served some years on the Lisbon and Mediterranean stations, chiefly in large line-of-battle ships, where, although in a healthy climate, he found consider-

able practice among the numerous crews (1,000 and more) crowded together in what would now be regarded as small vessels. While in the *Queen* flag-ship at Malta, in 1850, an epidemic of cholera broke out on board, in encountering which Assistant-Surgeon Smart's zeal and ability attracted favourable notice, and he won well-earned promotion. He now obtained his M.D. degree at Aberdeen, and a few years after the membership of the London College of Physicians.

Hitherto his Service career had been uneventful, but in 1854 the Russian war gave him an opportunity of distinction. His ship, the *Diamond*, at Sebastopol, was cleared of her crew, who went on shore as part of the Naval Brigade, under Captain, afterwards Sir William, Peel, son of the celebrated statesman. The vessel was temporarily converted into a hospital for the reception of the sick and wounded from the shore, and Dr. Smart was placed in charge. Afterwards, an hospital of huts having been erected for the Brigade at Balaclava, he continued to superintend it till the end of the siege. His admirable administration of this establishment, which enjoyed the great advantage of deriving abundant supplies from the Fleet, together with the skill and humanity he displayed in the treatment of the sick and wounded, was highly appreciated, and procured speedy recognition from the officers in command. His journal obtained the Gilbert Blane medal, the only purely professional distinction open to naval medical officers, and his report on the sanitary condition of the Naval Brigade was highly valued by the Commission of Inquiry, and included in their official report. Two war-medals and the Cross of the Legion of Honour were awarded for his Crimean services.

He was now appointed Staff-Surgeon of the hospital-ship at Hong Kong, where he had charge of those wounded in the naval operations in the Canton river, and remained four years in China, till after his promotion in 1859 to be Deputy Inspector-General. Next year he went to Bermuda to superintend the Naval Hospital for the usual term, and was afterwards transferred to Greenwich Hospital, then regarded as a life-appointment; but on the disestablishment of that institution he was, much to his chagrin, relegated to temporary retirement. It was now, as a solace for disappointment and in the negation of active professional work, always dearest to his heart, he plunged into a series of studies that greatly interested him—epidemiological, medico-political, antiquarian, historical, and geographical.

Residing in or near London, he was able to spend several

hours daily in the public libraries and record offices, and laborious nights in digesting his treasured acquisitions culled from the archives of the past. These severe, but to him pleasing, pursuits were interrupted by his promotion to Inspector-General and his appointment as chief of the great hospital at Haslar, where for four years he discharged his now purely administrative functions until his retirement by seniority in 1877. Honours meanwhile had flowed in abundance. He was nominated successively C.B. and K.C.B., and Honorary Physician to the Queen, and ultimately the good service pension was awarded him. When released from official work he embarked again with assiduity on a course of multifarious study, and published many valuable and instructive papers. He had also taken a warm life-long interest in all that related to the welfare of his brother-officers of the Navy, and an enormous amount of labour had devolved on him in the long struggle for the amelioration of their position; but he was fortunate in realising that the efforts conducted by himself and brother-officers with singular resolution and prudence had been crowned with success. The Naval Medical Service of the present generation is probably unaware of the deep obligation it is under to Sir William Smart and his coadjutors for their strenuous exertions on its behalf.

Sir William Smart's published contributions to epidemiology comprise a great variety of topics: "Bowel-Diseases in the Crimea", 1859; "Climatology and Diseases of Hong Kong", 1862; "Yellow Fever at Bermuda", 1864; "Dengue Fever", 1865; Diphtheria at Bermuda", 1866; Introductory addresses, 1873-4; "Epidemic Fevers of Seamen", 1883; "Old London Epidemics", 1884; "Asiatic Cholera in Fleets and Ships", 1886—all of which received respectful attention and elicited profitable discussion.

His last appearance in this room was at the opening meeting of 1887. He was still active in body and mind, but bore unmistakable traces of the wasting malady which had long afflicted him; and a few weeks afterwards (2nd December) he succumbed to the effects of a chill, having just completed his seventieth year. Many friends and colleagues, among whom were several members of the Society, paid him the last honours at Kingsbury Neasden, near Willesden.

Although Sir William Smart had great resolution and determination of character, he was eminently warm-hearted and sympathetic. In his family circle he had unalloyed happiness, and, in the companionship of a few intimate old

friends, he found the society he desired. Of a most liberal and generous disposition, wherever there was suffering and sorrow to be alleviated he was at hand with help and comfort. The kindest of relatives, the firmest of friends, he was never weary of well-doing, and by all who knew him his honoured name will be long remembered with affection and respect.

The Ordinary Meetings of the Society are held at

11, CHANDOS STREET, CAVENDISH SQUARE,

ON THE SECOND WEDNESDAY OF EACH MONTH FROM NOVEMBER TO JUNE INCLUSIVE, UNLESS OTHERWISE ANNOUNCED.

THE CHAIR IS TAKEN AT EIGHT O'CLOCK P.M. PRECISELY.

Subscriptions may be paid to the Treasurer. The Annual Subscription of Ordinary Members is One Guinea.

Ordinary Members are entitled to all privileges of membership, and to receive a copy of all the Society's publications issued during the year for which their subscriptions are paid. But Ordinary Members, resident beyond the limits of the Metropolitan Postal District, and having paid one or more annual subscriptions, may, on expressing a wish to that effect, be distinguished as Non-Resident Members.

Non-Resident Members are liable to an annual payment of half-a-guinea. They have the privilege of attending meetings, and are entitled to receive the publications of the Society issued during the year for which their subscription is paid; but they are not entitled to vote at meetings of the Society nor to hold office in it.

The Rules and Regulations of the Society, with an Exposition of its Objects, may be obtained from the Secretaries.

The Transactions for the Sessions 1859-60, 1866-67, *and* 1867-68 *are out of print. With these exceptions, those for the Sessions from* 1860-61 *to the last Session inclusive, may be obtained from the publishers,* Messrs. SHAW AND SONS, FETTER LANE, E.C. *Prior to* 1859-60, *the Transactions were published in the* "SANITARY REVIEW." *The issue of a New Series of the Transactions was begun in* 1882.